California Department of Transportation 2013

Main Street, California

A Guide for Improving Community and Transportation Vitality

The planning, design, maintenance and operational concepts discussed in this document are conceptually compatible with established traffic engineering and design practices, policies and standards. This document does not offer a prescriptive set of standards, but is a compilation of potential options for California State Highway (State highway) main street projects. The intended audience for "Main Street, California" includes California Department of Transportation (Caltrans) partners and stakeholders, as well as internal Caltrans staff.

This document is an informational guide that reflects many of the recent updates to Caltrans manuals and policies that improve multimodal access, livability and sustainability within the transportation system. "Main Street, California" helps the reader locate information about standards and procedures described in the Caltrans Highway Design Manual (HDM), the California Manual on Uniform Traffic Control Devices (California MUTCD), and the Project Development Procedures Manual (PDPM). Caltrans is committed to continual refinement of standards and policies that promote greater flexibility in developing State highway main streets that invigorate the vitality of local communities and the transportation system.

November 2013

I am pleased to present "Main Street, California." This expanded third edition includes greater emphasis on California State Highway main street investments that improve multimodal travel conditions and contribute to livable and sustainable communities.

Well-conceived main streets function efficiently as multimodal transportation facilities and are important civic spaces that support vibrant community life and ecological health. Prudent life-cycle investments by federal, state and local transportation agencies to provide multimodal travel options are a crucial strategy for reducing greenhouse gas emissions and other environmental impacts associated with single-occupancy driving habits. With an emphasis on system preservation, the California Department of Transportation is committed to working with local communities to improve connections to mass transit, and to increase the appeal of walking and bicycling on main streets.

Arriving at a shared vision for main streets requires a commitment to collaborative negotiation and shared responsibility. This document will assist transportation officials, designers, planners and stakeholders in making transportation decisions that are appropriate for the local context and that serve the greater traveling public.

Thank you for your interest in California State Highway main streets that enhance community and transportation vitality and improve mobility throughout the state.

Sincerely,

MALCOLM DOUGHERTY
Director

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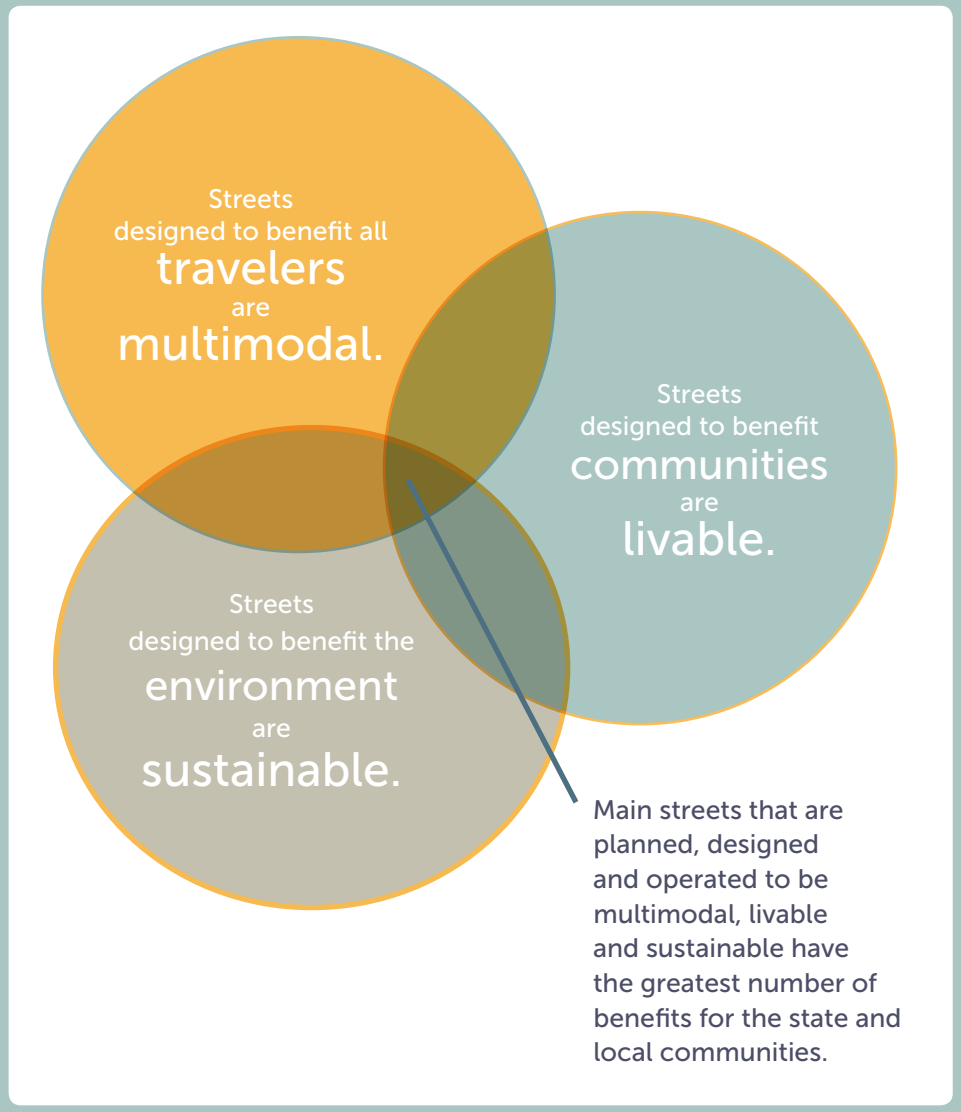
Above: Bridgeport has held an annual Fourth of July celebration for over 150 years. The parade route travels along Highway 395 (Main Street). For more information about required permits for parades and other special events that occur on State highways see the Caltrans Encroachment Permits website.

Introduction

Main streets are valuable to communities as transportation facilities that provide space for travel, daily activities and special celebrations such as parades, festivals and sporting events. Main streets that also function as California State Highways (State highways) are challenged with balancing local needs for a vibrant community street with the public's need for roadways that provide local, regional and statewide connections. Just as mobility is essential to California's economic and civic vitality, the planning, design and operation of main streets is tied to the prosperity and quality of life for local communities.

There is often more demand for roadway and roadside features than there is space to accommodate within the main street right of way. The professional judgment needed to address technical considerations and balance competing needs should be informed by the local context, the community's vision for main street and inclusive stakeholder participation.

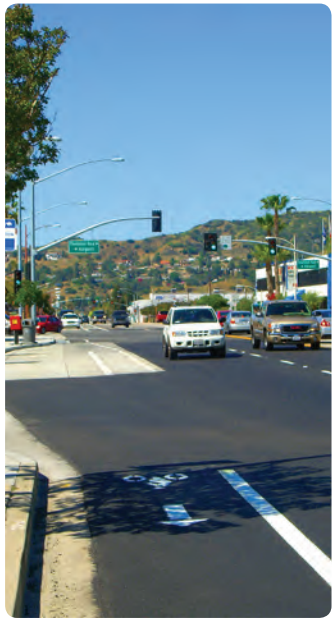
Transportation improvement projects are shaped by teams of engineers, planners, landscape architects and environmental and historic preservation professionals. Caltrans multidisciplinary teams are essential to identify and address a wide array of project needs, including the safety of all travelers and highway workers; multimodal access; transportation system efficiency; prudent initial and life-cycle fiscal investments; and environmental stewardship.



Some roadway features have overlapping multimodal, livability and sustainability benefits.

Since the planning, design, maintenance and operation of main streets impacts travelers, communities and the environment, this document explores all three of these topic areas. Strategic planning and design of main streets to provide mobility to all travelers, including complete streets concepts, are discussed under the theme of "multimodal travel." Strategies for creating main streets that benefit communities and the environment are discussed under the themes of "livability" and "sustainability."

Main streets that are both a community street and a State highway typically have motorized traffic speeds of less than 40 miles per hour and serve pedestrians, bicyclists, transit riders and drivers.



The concepts discussed in this guide may be applied to a wide variety of main street environments.

Main Streets and Communities of All Sizes

In cities, suburbs and small towns, livable main streets provide the freedom to choose the mode of travel that best suits individual trip requirements.

In developed areas, streets comprise a large percentage of public outdoor space, making it even more important for streets to function as special public places in their own right. Livable main streets serve as attractive shopping destinations, local magnets for pedestrians and as venues for public gatherings.

Creating favorable conditions for businesses along main streets can be a powerful engine for the local economy. Particularly in small communities, main street businesses may comprise a considerable portion of a town's tax base and may house a large number of local employers.

1 Main Streets Principles

State highways that are also Community main streets require planning and design solutions that are different than those for high-speed Interstate highways.

This chapter describes five guiding principles that can help maximize the number of livability, sustainability and multimodal benefits that main streets can provide for communities and the state.

Principle 1 Flexibility in Design

State highway main streets must accommodate the circulation of the local community as well as regional and statewide travel demands. Planning and designing main streets with principles of multimodal travel, livability and sustainability requires partnering with stakeholders to ensure that mobility and access needs are addressed in a manner that makes main street an asset to the local community.

Caltrans has an ongoing responsibility to enforce consistent application of highway design standards to ensure safety for the traveling public and for those who construct, operate and maintain State highways. Caltrans provides extensive design guidance and standards for the State Highway System in the "Highway Design Manual" (HDM). The HDM allows for some flexibility in applying design standards that take the context of the project location into consideration, enabling the designer to tailor the design, as appropriate, to the specific site.

> This guidance allows for flexibility in applying design standards and approving design exceptions that take the context of the project location into consideration, which enables the designer to tailor the design, as appropriate, for the specific circumstances while maintaining safety."
>
> Caltrans Highway Design Manual

An evaluation process exists to analyze design concepts that deviate from standards described in the HDM. Standards deemed "mandatory" are listed in Table 82.1A. "Advisory" design standards, which allow greater flexibility to accommodate design constraints, are listed in Table 82.1B. Design exception proposals are evaluated for potential effects on worker and traveler safety, mobility, maintainability and environmental quality.

Proposed design exceptions to mandatory or advisory standards should be identified early in project development. The procedures and documentation requirements for the evaluation of exceptions are described in the "Project Development Procedures Manual" (PDPM).

Principle 2

Partnerships: Caltrans, Communities and Stakeholders

The public entrusts considerable resources to Caltrans with the expectation of an efficient multimodal transportation network. Being wise stewards of fiscal and physical resources requires sound planning and engineering judgment, coupled with attentiveness towards stakeholder goals. Shared decision making facilitates the best possible outcomes and can streamline the process of arriving at mobility solutions that are responsive to the local context and community needs.

Collaborative negotiation enables effective and streamlined transportation solutions for main streets.

Caltrans works with local jurisdictions, transit providers, tribal governments and regional agencies to develop unified plans that address interregional multimodal travel and promote sustainable communities. Collaborative efforts ensure an integrated regional transportation system that enables multimodal main street highways to be an asset to the local community. More information about Caltrans state-level planning and how it complements regional transportation plans and land use plans is in Chapter 2, "Planning Main Streets."

Effective communication between main street project planners, designers, local communities and affected stakeholders begins in the planning phase and continues through project development, maintenance and operations. The section "Guidance on Engaging Stakeholders and Developing Community Responsive Projects" in Chapter 2 lists further guidance and resources.

A stakeholder may be anyone who is impacted by the physical design and operation of main street. Potential stakeholders can include community members; public and commercial multimodal travelers; local, state and federal transportation and planning agencies; elected officials; advocacy and civic interest groups; local businesses; officials from other public agencies such as school districts and emergency responders; and Caltrans representatives from areas such as maintenance, traffic operations and construction.

Collaborative discussions about main street projects should address potential options for:

Expanding the role of main streets in communities will often require stakeholders and local agencies to play an expanded role in planning, design, maintenance operations and/or ownership of main street.

Collaborative Options for Funding, Maintaining and Operating Main Street

Arriving at a shared vision for how to incorporate livability and sustainability principles into main street projects requires a creative and collaborative approach. Some design solutions will be familiar or slight variations of traditional strategies, while others will entail a new and broader vision of how main streets can benefit travelers and the local community.

Successful implementation of this expanded view of main streets may require collaboration not only during planning and design, but also during construction, operation and maintenance. Since transportation solutions will vary from place to place depending upon local context, transportation needs and the vision of the local community, it is important that early planning efforts include discussion of each partner's goals, needs, abilities and limitations.

To best serve community needs, some main street elements may need to be funded, designed, constructed, maintained and/or owned by communities or their local agencies. Caltrans and stakeholders must determine financial and maintenance activity commitments for proposed design elements during early planning and project development. Collaborative negotiation that identifies constraints and assigns roles and responsibilities (for various operational activities, roadway features and their associated funding) enables appropriate transportation decisions for the design of main streets. "Maintenance Agreements," "Cooperative Agreements," and "Relinquishment: Options for Ownership" are discussed in Chapter 2.

Principle 3

Main Streets for All

Multimodal Travelers
Users of multimodal roadway networks include pedestrians, bicyclists, public transit riders and motorists (in private, commercial or public vehicles such as cars, motorcycles, emergency response vehicles, trucks, buses, vans and recreational vehicles).

People often participate in several modes of travel within a single trip. Most trips include a pedestrian segment, such as walking from a bus stop or parked car to a final destination.

While motor vehicles provide clear advantages and conveniences for some trips, a multimodal transportation network maximizes options, providing people the freedom to choose their preferred mode of travel.

Main Streets Within a Multimodal Network
Multimodal transportation networks emphasize mobility and access for all users, options for modes of travel, connections between state and local roads and connections between modes (such as providing pedestrian access to a transit stop). Multimodal main streets respond to the needs of local communities, the statewide traveling public and the movement of goods and services.

Complete Streets
The phrase "complete streets" describes the incorporation of multimodal principles into the physical configuration of roadways and associated facilities. Streets are made "complete" by addressing the needs of all users of the system, although individual complete streets may not be identical in design or appearance, nor in the modes of travel they accommodate. Depending upon local context and environmental conditions, different streets will require distinct physical design features to best address the needs of travelers in that location.

As outlined in Caltrans "Deputy Directive 64-R1, Complete Streets - Integrating the Transportation System," Caltrans "views all transportation improvements as opportunities to improve safety, access, and mobility for all travelers in California and recognizes bicycle, pedestrian, and transit modes as integral elements of the transportation system." Complete streets are planned, designed, operated and maintained to provide mobility for all users, appropriate to the function and context of the facility.

The California Complete Streets Act of 2008 (Assembly Bill 1358) mandates that complete streets concepts be adopted by cities and counties in their general plans. Implementing complete streets and other multimodal concepts also supports the California Global Warming Solutions Act of 2006 (Assembly Bill 32) and the Sustainable Communities and Climate Protection Act of 2008 (Senate Bill 375), which outline California's goals for reducing greenhouse gas emissions through integrated land use and transportation planning.

Travelers with Disabilities

Since main streets are important community routes and destinations, it is especially important that access is provided for all travelers. Travelers with disabilities use any or all of the various modes of travel discussed in this guide. Beginning with planning and design and throughout construction, operation and maintenance of main streets, attention to specific design solutions and site conditions can enable mobility for travelers with disabilities, ensuring that the transportation system truly is accessible to all.

The Americans with Disabilities Act (ADA) and the California Government Code (CGC) prescribe that facilities shall be made accessible to persons with disabilities. Caltrans Design Information Bulletin (DIB) 82 provides current design guidance on compliance with the various federal and state laws that relate to pedestrian accessibility. The "Highway Design Manual" also discusses ADA design requirements in detail.

Left: Intersections, such as this one in Santa Monica, are utilized by pedestrians of varying ages and abilities. Right: Curb ramps with detectable warning surfaces are a key accessibility feature, as shown here in San Luis Obispo.

Left: Bicyclists and pedestrians are important to the financial health of local businesses along State Route 29 in Calistoga and State Route 75 in Coronado (right).

Integrating Biking and Walking

The integration of bicyclists and pedestrians into main street travel is essential to creating a truly multimodal and sustainable transportation system. Increasing the numbers of people biking and walking also improves community livability, public health and economic vitality. Chapter 2, "Planning Main Streets," explores planning strategies and requirements for ensuring that the travel needs of all modes are addressed from project conception through construction and operation.

"If comfort is low, the walk will be short, while if the route is interesting, rich in experience and comfortable, pedestrians forget the distance and enjoy experiences as they happen."

—Jan Gehl, "Cities for People"

Appropriate roadway design is critical for creating inviting travel conditions for bicyclists and pedestrians. Research shows that to make a meaningful impact on promoting active transportation, it is not merely an issue of allocating roadway space; it must also feel comfortable to bike and walk. After implementing strategic and integrated multimodal infrastructure improvements, many cities see notable increases in the number of people participating in active transportation. Chapter 3, "Designing Main Streets," explores a host of design and engineering strategies that can improve conditions for all travelers.

Creating comfortable biking and walking conditions improves the vitality of the transportation system and improves community livability. A main street that is welcoming to a full range of users will likely be more than just a preferred route of travel—it is also likely to become a desirable destination for socializing and visiting local establishments and services.

Integrating Connections to Public Transit

Public transit improves community livability by increasing access to civic, commercial and employment destinations. Public transit is also a fundamental component of sustainable transportation by reducing the number of single-occupancy vehicle trips. When travelers are able to replace single-occupancy vehicle trips with public transit, there are measurable environmental and public health benefits. Reducing the number of vehicles on the road can improve air quality by reducing congestion and green house gas emissions. Use of public transit also usually involves some accompanying form of active transportation, such as walking or biking from a transit stop to a final destination.

A sustainable multimodal main street offers access to public transit and connections between modes of travel. During planning and design of main street infrastructure, elements that support the operation of transit on main streets should be evaluated. The costs associated with constructing transit-related features may be the responsibility of the local or regional transit agency, Caltrans, or a combination of local, state and federal agencies.

Although Caltrans does not operate transit services, main street projects may be able to include features that improve access to transit facilities. Partnerships between Caltrans and transit providers will ensure that appropriate transit-related issues are addressed and resources are shared to coordinate system improvements on main streets. Coordination among agencies is important to assess existing and needed transit facilities and to evaluate all applicable planning documents (such as general plans and short and long-range transit plans). Incorporating transit improvements into early planning documents will increase the likelihood that they are added to main street projects.

Chapter 2, "Planning Main Streets," describes how local transportation needs, including those related to transit, are evaluated in the planning phase. More information about designing for connections to transit can be found in Chapter 3, "Designing Main Streets."

Principle 4 Livable Main Streets

Livability refers to the degree to which the public realm improves the quality of life for people who use the space. Transportation facilities that improve livability are inviting, accessible to all travelers, contribute to improved public health and enhance economic, community and environmental vitality.

Livability: Place Making and Community Identity

Livable neighborhoods require that streets function as transportation facilities and viable public places. Communities may have goals of preserving historic or unique elements along main streets; inviting suitable new businesses and development; and energizing public spaces for civic activities and community celebrations such as parades and special events.

Livable streets include roadway and roadside features that improve a community's quality of life and unique sense of place.

Preserving a "sense of place" or "place making" is the process of supporting and enhancing elements that make a community livable, unique and economically viable. Within the context of transportation projects, place making improves practical aspects of civic life, such as by providing connections between homes and neighborhood centers. Place making also addresses harder to quantify livability issues, such as socially cohesive neighborhoods and community identity. Transportation improvements alone cannot address every component of place making, but they can significantly bolster community efforts to create and preserve a rich and unique sense of place.

Main streets that are comfortable for walking and bicycling that also include inviting street features such as trees, landscaping and street furnishings, are more likely to function as successful travel corridors, livable neighborhood centers and desirable locations for visitors and businesses. Chapter 3 describes specific roadway and roadside features that can improve main street livability.

Livable main streets convey a sense of place and enable communities to thrive.

Photo previous page: An annual July 4th parade in Piedmont is a popular community event that follows city streets, ending at city hall.

Top left: State Route 395 in Lone Pine and State Route 28 in Sunnyside-Tahoe City (above right), are on the eligibility list for State Scenic Highways and serve local residents as well as tourists visiting nearby scenic areas.

Main Street Scenic Highways and Byways

State Scenic Highway and National Scenic Byway designations are intended to recognize and preserve the inherent scenic, natural, historic, cultural, recreational and archeological qualities along a highway. Main streets may serve as gateways to scenic corridors, or they may meet the criteria to be designated as State Scenic Highways or National Scenic Byways.

Designation under these programs may enhance a community's local identity, increase land values by maintaining the scenic character of the corridor and improve the local economy by attracting tourists to the area.

A community is responsible for identifying its visual resource assets and developing design guidance, corridor protection or corridor management plans to preserve them under the Scenic Highways and Byways Programs. Caltrans administers the State Scenic Highways Program and provides additional information on the Caltrans Landscape Architecture website.

The Caltrans State Scenic Byway Coordinator assists with the National Scenic Byway Program. More information is available on the National Scenic Byway Program website.

Principle 5 Sustainable Main Streets

Within transportation projects, sustainability balances safety and life-cycle requirements of transportation facilities with stewardship of natural, social and economic resources. Main streets that support sustainable transportation systems are inviting to a full range of travelers. Providing comfortable conditions for biking, walking and taking public transit encourages people to choose the mode of transportation that best accommodates the requirements of their trip. Replacing single-occupant driving trips with walking, bicycling, or taking public transit has numerous environmental and public health benefits.

Physical roadway improvements that address all travel modes can support local and regional land use and transportation plans. Chapter 2, "Planning Main Streets," describes how multimodal transportation needs are evaluated in both long-range planning and in project planning for main streets.

Left: A sustainable transportation system maximizes options and provides travelers the freedom to select the mode of travel that best suits their needs. Right: Streets can include sustainable features, such as this landscaped storm water treatment area on State Route 123 (San Pablo Avenue) in El Cerrito.

Streets themselves can be designed and operated to include techniques or materials that support sustainability. Chapter 4, "Sustainable Main Streets," highlights how roadway and roadside features can support ecological health and highlights construction techniques and materials that can minimize negative impacts on the environment.

Main streets that are planned to support local and regional sustainability goals and that also include features or materials that contribute to ecological health, will have the greatest number of sustainability benefits for the state and local communities.

Evaluating Main Street Improvements and Land Use

Adjacent land use dramatically influences the vibrancy of main streets. While Caltrans does not have direct control over adjacent land uses, transportation facilities and development patterns heavily influence each other. It is therefore important for Caltrans and local agencies to maintain partnerships in the planning stage to ensure that main street projects support mutual transportation, development, livability and sustainability goals. The Caltrans "Smart Mobility Framework" outlines a planning framework that guides and assesses how well plans, programs and projects meet a definition of "smart mobility," including integrating transportation and land use.

Caltrans also participates in Transit Oriented Development (TOD) and Infill Development efforts. The Caltrans "Statewide TOD Study: Factors for Success in California" examines the benefits of linking land use with transportation facilities. The study found that TODs can provide greater mobility choices; increase household disposable incomes; enhance conservation of farmland and natural habitats; reduce vehicle miles traveled and associated emissions; improve economic development; and reduce infrastructure costs. Some main street locations may be candidates for TOD projects.

Sustainable Main Streets

Stewardship of natural resources

- Walking, bicycling and using public transit all reduce the number of trips made by single-occupant vehicles. Reducing the number of vehicle miles traveled results in reduced particulate and green house gas emissions, improved air and water quality and reduced fossil fuel consumption.
- Use of sustainable construction methods, recycled and reclaimed materials and locally available resources can benefit the environment and local economy.

Stewardship of economic resources

- Multimodal systems promote the most efficient use of the transportation network. Providing options for modes of travel can reduce agency, stakeholder and traveler costs.
- Designing multimodal systems with principles of sustainability can reduce fiscal expenditures related to public health (due to improved cardiovascular health for users of active transportation modes and cleaner air and water for all).
- Since roadway construction and maintenance costs correlate directly to vehicle size and weight, bicycle and pedestrian infrastructure is generally less expensive per mile to install and maintain than traffic lanes designed for motor vehicles.

Stewardship of social resources

- Sustainable main streets are multimodal and provide public benefits by enabling communities to utilize main streets as both a travel facility and a valuable public space; facilitating active transportation and improved public health; and providing inclusive access to the transportation network.

Sustainability and Inclusivity
An inclusive transportation system provides access for all travelers to reach social and economic opportunities. Providing multimodal options for travel to housing, employment, school, open spaces and commerce contributes to social and economic sustainability for rural, urban and suburban communities.

Building an inclusive transportation system requires engaging citizens in setting goals for projects and forming partnerships with municipalities and agencies that are pursuing planning and development efforts to link land use with transportation facilities.

Above: This segment of State Route 16 in Esparto provides mobility options for a wide range of users.

Fiscally Sustainable Main Streets: Building Prosperity by Design

Statewide Return on Main Street Investments
Caltrans must ensure that transportation investments, including those along California's main streets, are cost effective and efficient from the initial capital expenditure through maintenance and operations.

Caltrans uses Life-Cycle Cost Analyses (LCCA) to evaluate the pavement costs of particular designs including initial costs; expenditures related to future maintenance, rehabilitation and known upgrades; and user costs to public and commercial drivers. It includes an analysis of the investment needed to maintain an established level of service over the life of the facility.

Main street projects may also undergo cost benefit analysis as part of Value Analysis (VA) studies. VA studies are multidisciplinary evaluations of projects that generate recommendations on how to improve project quality while meeting high standards for safety and environmental stewardship. VA recommendations emphasize strategies that can minimize construction and life-cycle costs and reduce construction time. More information can be found on the Caltrans VA website.

Community Return on Main Street Investments
Just as an efficient transportation system is the backbone of the national economy, a well conceived main street can connect communities to the larger state, national and even global economy. A main street that houses business and retail, provides services for commercial goods and freight movement, provides employment opportunities for local residents and attracts both tourists and local customers, can function as a powerful engine for the local economy.

Main Street Investments that Build Prosperity

Main street transportation projects can profoundly shape communities beyond the intended benefits to the transportation system. Improvements that incorporate principles of livability, sustainability and multimodal travel can have fiscal benefits for communities, individuals, the state and even the nation.

The photographs on these two pages highlight how specific multimodal, livable and sustainable features may lead to widespread economic returns. Each numbered statement corresponds to documented research findings cited at the end of this chapter.

Cities, Towns and Regions Prosper

1 **Revenue and Employment Opportunities**
Livable streets have higher commercial occupancy rates, increasing a town's tax base and employment opportunities.

2 **Special Events and Tourist Attractions**
Livable streets provide space for community events that encourage people to visit. Tourist spending can be a vital infusion of revenue and employment opportunities into a community.

Local Business Prospers

3 **Business and Retail**
Tourists are attracted to destinations that possess an appealing and distinctive character, also called "sense of place." Street improvements that contribute to making main street a memorable and inviting destination can bolster tourism.

4 People prefer to linger and shop along tree-lined streets, and they are attracted to commercial areas on streets with traffic calming features.

Top left: Locals and tourists frequent businesses along this popular livable tree-lined city street in Santa Barbara. Bottom left: Exeter hosts the Amgen Tour of California, one of the nation's largest cycling races. The race route typically includes several State highways, attracting international attention to cities and towns across California.

Taxpayers Prosper

Multimodal Streets and Networks

5 Roadway construction and maintenance costs correlate directly to vehicle size and weight. Walking and cycling cause less wear and tear on pavements, reducing life-cycle construction and maintenance expenditures.

6 Multimodal networks utilize space more efficiently than roadways built primarily for single-occupant vehicles; biking, walking and public transit can move more people in less space.

Street Trees

7 The shade provided by street trees cools pavement which can extend pavement life and reduce road maintenance expenditures.

8 Street trees can be a low cost component of storm water management strategies. Trees and other vegetation intercept rainfall and can help regulate the flow of storm water into storm drains and receiving water bodies.

Top left: More than a dozen bicyclists stop at a rest-station in San Jose as part of Bike-to-Work Day, a national event that promotes bike commuting as a mode of travel that improves personal and environmental health. Top right: Businesses benefit from livable streets that invite shoppers to stroll and shop along State Route 49 in Angels Camp. Below right: Trees and landscaping along State Route 9 in Ben Lomond provide livability and environmental sustainability benefits.

Individuals Prosper

Reduced Transportation Costs
Multimodal networks provide the freedom to choose travel options that can minimize household transportation expenses.

Reduced Energy Costs
Shade provided to rooftops by street trees can significantly reduce a structure's cooling expenditures and extend the life of roofing materials.

Increased Property Values
Residential property values are higher along tree-lined streets and in livable, walkable neighborhoods.

Local Shopping, Recreation and Neighborhood Centers
Livable streets and neighborhoods provide access to local retail and recreation opportunities, minimizing time spent in traffic.

Walking and biking can also be a social activity shared between people, strengthening bonds between family members and neighbors.

Health
Multimodal networks enable active transportation choices such as walking and bicycling, which can dramatically reduce diseases associated with obesity and sedentary lifestyles.

Multimodal networks encourage the reduction of motor vehicle trips, which can reduce health risks associated with poor air quality.

Traveling along livable tree-lined streets reduces stress related ailments by providing aesthetic enjoyment and a connection to nature.

California and the Nation Prosper

Main streets that enable multimodal travel can contribute to reduced single-occupant driver trips, which can in turn benefit California and the nation, as described below.

Greenhouse Gas Reductions
Replacing single-occupant driving trips with a form of active transportation is one of the most cost effective strategies for reducing greenhouse gas emissions.

Improved Water Quality
Decreasing single-occupant driving trips improves water quality by reducing the airborne pollutants that enter water bodies.

Sustainable streets designed to treat storm water runoff also improve water quality, thereby reducing government expenditures related to treating storm water.

Improved Air Quality
Decreasing single-occupant driving trips reduces vehicle emissions and congestion, resulting in reduced public health costs associated with poor air quality.

Public Health Savings
Encouraging active transportation such as walking and bicycling as a frequent mode of travel can reduce state and federal public health spending.

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Guidance on Engaging Stakeholders and Developing Community Responsive Projects

CALTRANS RESOURCES

Director's Policy: Context Sensitive Solutions (CSS)
Caltrans uses CSS to plan, design, construct, maintain and operate its transportation system.
http://www.dot.ca.gov/hq/oppd/context/

How Caltrans Builds Projects
A concise overview of the Caltrans project delivery process.
http://www.dot.ca.gov/hq/oppd/proj_book/HCBP_2011a-9-13-11.pdf

Project Development Procedures Manual (PDPM)
(Chapter 1: Project Development Philosophy; and Chapter 22: Community Involvement) The project development process seeks to provide mobility in balance with other values. Meaningful stakeholder involvement ensures that economic, social and environmental effects are considered along with technical issues.
http://www.dot.ca.gov/hq/oppd/pdpm/pdpmn.htm

Project Communication Handbook
Assists the project team in developing the Project Communication Plan and identifying internal and external stakeholders.
http://www.dot.ca.gov/hq/projmgmt/documents/pchb/project_communication_handbook_2nd_ed.pdf

ADDITIONAL RESOURCES

Federal Highway Administration (FHWA)- CSS Primer
This document provides guidance on how to incorporate CSS principles into projects in order to support livable communities and sustainable transportation.
http://www.fhwa.dot.gov/context/css_primer/

FHWA- Public Involvement Techniques for Transportation Decision-Making
http://www.fhwa.dot.gov/planning/public_involvement/publications/techniques/

Integrating CSS into Transportation Practice
Technical guidance for State Departments of Transportation; tribes; and federal, regional and local agencies seeking to integrate CSS principles into projects.
http://contextsensitivesolutions.org/

Mineta Transportation Institute- The Nature of CSS, Stakeholder Involvement and Critical Issues in the Urban Context
This report emphasizes stakeholder involvement in urban projects.
http://transweb.sjsu.edu/project/2610.html

National Cooperative Highway Research Program (NCHRP): Public Participation Guide, A Guide to Best Practices for Achieving CSS (NCHRP Report 480)
http://www.trb.org/main/blurbs/163304.aspx

NCHRP- Going the Distance Together: A Citizen's Guide to CSS for Better Transportation
This document highlights how CSS is designed to allow citizens to engage in all aspects of transportation planning.
http://www.trb.org/main/blurbs/166933.aspx

Additional Resources

AASHTO "The Road To Livability: How State Departments of Transportation are Using Road Investments to Improve Community Livability"
https://bookstore.transportation.org/item_details.aspx?ID=1596

Caltrans Deputy Directive 64-R1, Complete Streets
http://www.dot.ca.gov/hq/tpp/offices/ocp/complete_streets_files/dd_64_r1_signed.pdf

Caltrans Statewide Transit-Oriented Development Study: Factors for Success in California
http://www.dot.ca.gov/hq/MassTrans/Docs-Pdfs/TOD-Study-Final-Rpt.pdf

Caltrans Value Analysis (VA)
http://www.dot.ca.gov/hq/oppd/value/

California Complete Streets Act of 2008 (AB 1358)
http://www.leginfo.ca.gov/pub/07-08/bill/asm/ab_1351-1400/ab_1358_bill_20080930_chaptered.pdf

California Scenic Highways Program
http://www.dot.ca.gov/hq/LandArch/scenic_highways/scenic_hwy.htm

Federal Highway Administration "Livability in Transportation Guidebook"
The guidebook explores how transportation planning and programs can improve community quality of life, enhance environmental performance, increase transportation and housing choice and support economic vitality.
http://www.fhwa.dot.gov/livability/case_studies/guidebook/

National Scenic Byway Program
http://www.bywaysonline.org/

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2 Planning Main Streets

Main street planning begins as part of broader regional multimodal, sustainable and livable transportation goals in the long-range planning stage. Long-range planning evaluates transportation system needs across regions and the state. It is followed by project specific planning, which considers both regional impacts and site specific context and conditions.

The following chapter describes how principles of multimodal travel, livability and sustainability are considered in both long-range and project planning of main streets.

Main street planning begins as part of broader regional multimodal, sustainable and livable transportation goals in the long-range planning stage.

Main Street

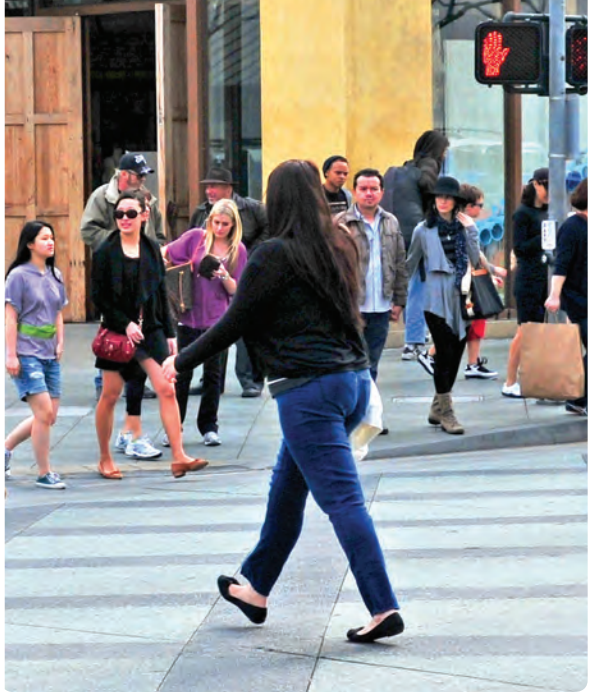
Long-Range Planning

The California Transportation Plan

Every five years, Caltrans updates the California Transportation Plan (CTP), which has a minimum 20-year planning horizon. The CTP, developed over several years with widespread stakeholder participation, articulates a vision for a statewide transportation system that complements regional transportation plans and land use goals. The CTP enables a unified strategy for meeting interregional multimodal travel needs; reaching maximum feasible greenhouse gas emissions reductions; and supporting national, local and statewide policies and mandates relevant to the transportation system.

Long-Range System Planning

To set a 20-25 year vision for each State highway, Caltrans System Planning evaluates existing and future operating conditions on the State Highway System and recommends improvements to system operations. This process evaluates current conditions (which may include identifying the presence of main streets), land use, community characteristics and bicycle, pedestrian and transit facilities. Goals, policies, findings and proposals are documented in District System Management Plans (DSMPs), Transportation Concept Reports (TCRs), or Corridor System Management Plans (CSMPs).



Caltrans collaborates with local jurisdictions, transit providers, tribal governments and regional agencies on updates to DSMPs, TCRs and CSMPs to better align mutual goals for the corridor, including main street segments. If a local or regional agency wishes to pursue a State highway main street project that is not currently identified by the TCR, the agency may complete a planning study to determine the feasibility of the project. This study can be funded by the local agency or through a competitive grant program administered by Caltrans.

Regional Transportation Plans

Caltrans participates in the development and review of Regional Transportation Plans (RTPs) prepared by Metropolitan Planning Organizations (MPOs) and Regional Transportation Planning Agencies (RTPAs). RTPs shape the future of the region's multimodal transportation system for the next 20 years or more. Collaborative RTP development provides opportunities for stakeholders and the public to participate in the development of the plan.

With the passage of Senate Bill 375, RTPs prepared by MPOs must include a "Sustainable Communities Strategy" which demonstrates how the region will meet its greenhouse gas reduction targets through integrated land use, housing and transportation planning.

Project Development Phase

Drawing upon previous planning documents and strategies, projects that address identified transportation issues enter the project development phase. During project development, potential transportation improvements are evaluated by Caltrans or a local entity.

Key conclusions and decisions are recorded in a series of reports that outline the purpose and need of the project, preliminary cost estimate information, the process for stakeholder involvement in decision making, proposed members of the multidisciplinary project development team (including applicable local entities), required environmental documentation, viable project alternatives and project specific features. The information recorded in these reports informs the next phase, which is project design. Mandatory policies and procedures for project development can be found in the "Project Development Procedures Manual" (PDPM).

Since the final scope and budget of projects are set in the project development phase, it is important for main street improvements to be adequately identified at this stage. Specific attention to principles of sustainability, livability, complete streets and the needs of multimodal travelers at this stage will facilitate the inclusion of these strategies into design, construction and maintenance activities. An overview of the Caltrans project development process can be found in the booklet "How Caltrans Builds Projects."

Cooperative Agreements

Any project within Caltrans right of way that is sponsored by a local entity requires a Cooperative Agreement (Co-op). A Co-op is a legally binding contract that defines the project scope and assigns roles and responsibilities, funding commitments, schedule and any other important arrangements on which parties must agree. An executed Co-op is required before Caltrans can commit funds or resources to assist other entities with the development and construction of any project within Caltrans right of way. Cooperative Agreements should be initiated during the planning phase of project development. More information is on the Caltrans Cooperative Agreement website.

Left: Former State Route 275 is relinquished Caltrans right of way in West Sacramento. Right: Relinquishment of the sidewalks may be an option where cities want to permit commercial use of the sidewalks, as shown in this cafe seating area along a city street in Winters.

Relinquishment: Options for Ownership

In some cases it may benefit the community to accept ownership of all or a portion of a State highway main street, which is accomplished through the relinquishment process. A relinquishment is a conveyance of all rights, title and interests of a State highway, or portion thereof, to a county or city. The relinquishment of facilities, such as the roadway, sidewalks, or both, allows local agencies to assume the administration, planning, design, construction, maintenance and operation of that facility. Relinquishment options should be initially evaluated in the early planning phase and throughout project development.

The removal of a State highway, either in whole or in part from the State Highway System, requires a relinquishment approved by the California Transportation Commission (CTC). Authority for the CTC to relinquish is given in Streets and Highways Code, Section 73, which outlines different types of relinquishments, including "nonmotorized transportation facilities: pedestrian ways, bike ways and equestrian ways."

Relinquishment of Caltrans right of way is discussed in Chapters 13 and 25 of the PDPM and in Chapter 6 of the "Right of Way Manual."

To ensure the safe and efficient performance of state facilities, Caltrans maintenance workers provide routine maintenance, perform emergency repair due to accidents, storms and natural disasters and clear roadways of accidents and roadway debris. Caltrans maintains more than 50,000 lane miles, 12,000 State highway bridges and 350,000 acres of roadside.

Maintainability

Caltrans strives to plan and design transportation facilities that are safe and efficient to maintain. This broad concept entails consideration of the life-cycle of materials, the likelihood of needed repairs and upgrades, the degree of special expertise or training required for maintenance activities, the number of workers needed for specific maintenance activities and strategies for minimizing vandalism.

Elimination of excessive maintenance requirements is vital to reduce worker exposure to the dangers of traffic and driver distraction.

Every project will require maintenance over its lifetime. Since planning and design decisions about roadway and roadside features and materials impact maintenance needs, it is vital that maintenance managers be included as early stakeholders in project development. Strategies that minimize maintenance activities are fiscally prudent, and even more importantly, they reduce the frequency and duration of highway worker exposure to traffic dangers.

Since roadway and roadside maintenance activities expose workers to traffic dangers, every effort should be made to employ designs, materials and maintenance techniques that minimize worker exposure risks. Many of the traffic calming strategies discussed in Chapter 3 can help reduce driving speeds and traffic conflicts, which may improve conditions for maintenance workers as well as for main street travelers.

Right: The proper repair of decorative brick paving involves locating pavers that match in color and dimension and may require a trained bricklayer. This is an example of a skilled trade not regularly employed by Caltrans and a specialized building material that may be difficult to locate and obtain.

It is often in the best interest of local governments or agencies to care for the facility via a Maintenance Agreement if proposed main street features will require specialized care, materials, or equipment to ensure proper maintenance. Early communication between Caltrans and local partners can help define respective needs, abilities and limitations.

Maintenance Agreements

Maintenance Agreements describe specific locations of work, funding sources, the responsibilities of the entities that will perform specific activities, and the standard of maintenance that is required. They may also include information pertaining to manufacturer's warranties and applicable laws, mandates and regulations. Maintenance Agreements are required any time a community or local agency assumes responsibility for maintaining an area or specific element within Caltrans right of way.

The potential need for a Maintenance Agreement should be identified in the planning phase of project development. A process of collaborative negotiation can help define maintenance issues more thoroughly by identifying the abilities and limitations of the various parties, as well as the life-time maintenance needs of various proposed main street features. Early discussions may also lead to design solutions and material choices that are easier and less costly to maintain, while still meeting project goals. A field review that includes all individuals who are authorized to negotiate and commit to the terms, maintenance responsibilities and limits of work is valuable to creating a thorough Maintenance Agreement.

Existing Maintenance Agreements should be reevaluated when additional improvements are made in the area. The agreement may need to be amended to include updated information about the type of work, site location(s), or funding sources. Modification to an existing Maintenance Agreement and the creation of new Maintenance Agreements must include consultation with the Caltrans Legal Division.

More information is provided in the Caltrans "Maintenance Manual" in Chapter 1. The PDPM discusses Maintenance Agreements and other project permits and agreements in Chapter 13 and throughout the PDPM as appropriate.

Caltrans Planning Resources

DIVISION OF TRANSPORTATION PLANNING
http://www.dot.ca.gov/hq/tpp/

California Interregional Blueprint
http://www.dot.ca.gov/hq/tpp/californiainterregionalblueprint/

California Transportation Plan 2025
http://www.dot.ca.gov/hq/tpp/offices/osp/ctp2025.html

Complete Streets
http://www.dot.ca.gov/hq/tpp/offices/ocp/complete_streets.html

Project Scoping Coordination
http://www.dot.ca.gov/hq/tpp/offices/opsc/index.html

Planning Grants Program
http://www.dot.ca.gov/hq/tpp/grants.html

System Planning
http://www.dot.ca.gov/hq/tpp/offices/oasp/index.html

COMMUNITY PLANNING RESOURCES
for Livable and Sustainable Transportation Networks

Office of Community Planning (OCP)
The OCP emphasizes public participation and coordination between agencies and jurisdictions; and it is a resource for potential grant funding for enhanced public engagement during early transportation studies, which can include studies related to main streets.
http://www.dot.ca.gov/hq/tpp/offices/ocp/index.html

Caltrans Smart Mobility Framework (SMF)
The SMF is a planning tool for incorporating livability and sustainability principles into the development of plans, programs and projects at the community design and regional level.
http://www.dot.ca.gov/hq/tpp/offices/ocp/smf.html

Community Primer on Environmental Justice and Transportation Planning
The primer identifies how the general public and traditionally underrepresented communities can participate in the transportation decision making process.
http://www.dot.ca.gov/hq/tpp/offices/ocp/ej_titlevi_files/EJ_Primer_4_10_WEB.pdf

Planning Public Engagement Contract (PPEC)
The PPEC provides funding to Caltrans Headquarters and Districts for a consultant to enhance public engagement and outreach efforts during Caltrans' early transportation studies.
http://www.dot.ca.gov/hq/tpp/offices/ocp/public_participation/pp.html

Public Participation Outreach Projects-
Final Project Summary Report
A compendium detailing how the public participation process was successfully implemented in local, regional and statewide projects through the PPEC.
http://www.dot.ca.gov/hq/tpp/offices/ocp/pp_files/new_ppe/project_summaries/MIG_2006-11_FINAL_REPORT.pdf

Additional Caltrans Resources

DISTRICT MAP
Caltrans is divided into 12 Districts, as shown on this map.
http://www.dot.ca.gov/localoffice.htm

ORGANIZATION CHART
http://www.dot.ca.gov/orgchart/departmentalorgchart.pdf

DIVISION OF BUSINESS SERVICES AND SECURITY
http://admin.dot.ca.gov/bfams/admin_svcs/sw_policy/

Deputy Directive 103, Worker Safety on the State Highway System
Safety for all workers is a critical component of all activities performed on the State Highway System by Caltrans and its partners.
http://admin.dot.ca.gov/bfams/admin_svcs/sw_policy/dd/dd_103.pdf

DIVISION OF DESIGN
http://www.dot.ca.gov/hq/oppd/index.htm

Cooperative Agreements
http://www.dot.ca.gov/hq/oppd/coop/

How Caltrans Builds Projects
http://www.dot.ca.gov/hq/oppd/proj_book/

Project Development Procedures Manual (PDPM)
http://www.dot.ca.gov/hq/oppd/pdpm/pdpmn.htm

DIVISION OF LOCAL ASSISTANCE
http://www.dot.ca.gov/hq/LocalPrograms/

Bicycle Transportation Account
Local agencies possessing a Bicycle Transportation Plan approved by their local Regional Transportation Planning Agency are eligible to apply to the Caltrans Bicycle Transportation Account, which funds city and county projects for bicycle commuters.
http://www.dot.ca.gov/hq/LocalPrograms/bta/btawebPage.htm

Safe Routes to School Programs
http://www.dot.ca.gov/hq/LocalPrograms/saferoutes/saferoutes.htm

DIVISION OF MAINTENANCE
http://www.dot.ca.gov/hq/maint/

Maintenance Manual
http://www.dot.ca.gov/hq/maint/manual/maintman.htm

DIVISION OF MASS TRANSPORTATION
http://www.dot.ca.gov/hq/MassTrans/

Bus Rapid Transit
http://www.dot.ca.gov/hq/MassTrans/Brt.html

Additional Planning Resources

All information provided by sources external to Caltrans must be evaluated for consistency with Caltrans policies and guidance.

STATE RESOURCES

California Complete Streets Act of 2008, AB 1358
AB 1358 requires revised city or county general plans to address multimodal transportation network issues in a manner that is suitable to the rural, suburban or urban context of the general plan.
http://www.leginfo.ca.gov/pub/07-08/bill/asm/ab_1351-1400/ab_1358_bill_20080930_chaptered.pdf

Governor's Office of Planning and Research (OPR)
The OPR provides guidance on implementing AB 1358 in the document: "Update to the General Plan Guidelines: Complete Streets and the Circulation Element."
http://opr.ca.gov/docs/Update_GP_Guidelines_Complete_Streets.pdf

Institute for Local Government (ILG)
The ILG, the research and education affiliate of the California State Association of Counties and the League of California Cities, provides educational resources and grant program information related to sustainable design, development and planning.
http://www.ca-ilg.org/

California Strategic Growth Council (SGC)
The SGC administers grant programs and provides information to state agencies on issues such as environmental protection and sustainable development.
http://www.sgc.ca.gov/

NATIONAL RESOURCES

American Planning Association (APA)
The APA publishes an annual list of "Ten Great Streets" as part of the "Great Places in America" recognition program.
http://www.planning.org/greatplaces/

Federal Highway Administration
The Transportation Planning Process: Key Issues
A book for government officials, transportation decision makers, planning board members and transportation service providers with an overview of transportation planning. It defines key concepts in statewide and metropolitan transportation planning.
http://www.planning.dot.gov/documents/BriefingBook/BBook.htm

Transportation Planning and Forecasting Research at The Transportation Research Board
An online compilation of federal, state, academic and international research related to transportation planning and forecasting.
http://www.trb.org/PlanningForecasting/PlanningandForecasting1.aspx

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3 Designing Main Streets

Livable main streets function as the heart of the community, providing space for travel and community life. The creation of livable streets is much more than the incorporation of complete streets concepts; it is a more nuanced result of careful design. Livable streets are special in character and can contribute to a community's identity and local economy. This chapter includes a variety of design strategies that can contribute to livable multimodal main streets.

There are likely to be competing demands for space within the main street public realm. Due to the considerable diversity of communities and site conditions, planners and designers should select design features on a project-by-project basis. Design features should be selected based on an understanding of multimodal travel needs, community and stakeholder concerns, local and regional context, sound engineering and design judgment, maintenance requirements, life-cycle costs and thorough consideration of the benefits and trade-offs of various alternatives.

Refer to Chapter 2 for discussion of

Maintainability, Maintenance Agreements, Relinquishments and Cooperative Agreements

that may need to be addressed prior to the installation and maintenance of some of the features included in this chapter.

Livable Main Street Design and Traffic Calming

Livable streets balance the needs of all travelers and serve as inviting public places to visit, not just to travel along. Where fast moving vehicles discourage people from biking and walking on main street, traffic calming features can help bring the traffic speeds down to a level that balances the needs of all travelers and improves the livability of the street environment overall.

Traffic calming through physical design such as modifying intersections or reallocating traffic lanes to make space for bike lanes, sidewalks and landscaping, improves livability by making main street an inviting and multifunctional public space.

The Institute of Transportation Engineers defines traffic calming as a "set of techniques, consisting mostly of physical features, to affect vehicle operations on one or more streets to improve the street environment for other users (i.e., those not using motorized vehicles)." The Federal Highway Administration (FHWA) states that "traffic calming utilizes design strategies to slow down cars and increase the visibility of pedestrians and bicyclists."

Research shows that livable roadway and roadside features can signal appropriate driving speeds to drivers. Some livable features serve as visual cues, communicating that the roadway is shared among multiple modes.

"*Traffic calming* utilizes design strategies to slow down cars and increase the visibility of pedestrians and bicyclists."

Roadway and roadside features that improve main street livability and strengthen traffic calming measures:

- Street trees, sidewalk planting strips and planters
- Sidewalks, which visually and physically designate pedestrian and community space
- Raised medians with pedestrian crossings and landscaping
- Transportation art, community identifiers and gateway treatments
- Ornamental lighting, street furniture, and transit facilities
- Pedestrian and bicyclist signs, markings and facilities
- Textured or colored pavement for crosswalks and intersections

Drivers tend to slow driving speeds when they perceive that bikes and pedestrians are likely to be present and when the design of the main street conveys that it is more than just a travel conduit; it is a shared and valued community space.

Improving the livability of main streets by implementing traffic calming measures may result in slower vehicle speeds and increased driving travel time. The potential impact to driver travel time (measured in seconds or minutes of motor vehicle delay) is analyzed as one of the potential impacts to consider when weighing project options. To meet local community goals, main street stakeholders may prioritize the livability benefits of traffic calming improvements over any potential driving travel time reductions.

This chapter outlines design features that may be employed as components of best practices in livable street design.

Balanced Main Street Roadways and Intersections

Balanced main street roadways and intersections address the needs of pedestrians, bicyclists, transit riders and motorists.

The following section describes some of the options for allocating roadway space to best meet the transportation and community needs on each unique main street. The described options are not intended as a recommendation for one solution over another, nor are they presented in order of priority or preference. Main street solutions will be as varied as the communities in which they exist.

Planners and designers typically work in areas of fixed boundaries, with competing user demands for main streets. In areas of finite space, accommodating the needs of all travelers, supporting adjacent land uses and incorporating utilities, drainage facilities and other functional facilities should be balanced to provide the most successful solutions for each main street. The dimensions of all roadway and roadside features should be analyzed on a case by case basis to determine how to best balance all of the competing needs in each situation.

Left: This city of Auburn streetscape project enhances business visibility, improves pedestrian access and revitalizes the historic and aesthetic quality of the corridor. The redesign included geometric realignment of the intersection, parking realignment, decorative lighting, street furnishings, street tree plantings and planted areas that provide storm water treatment benefits.

Setting the Speed Limit

If a community desires slower speeds along a main street, the first strategy is to implement physical traffic calming features. This may allow subsequent lowering of the posted speed limit. Research shows that motorists tend to drive at the speed at which they feel comfortable, based on the design of the road and current roadway conditions, even when their driving speed is incongruent with the posted speed limit. A posted speed limit that drivers perceive as arbitrarily low given the actual roadway conditions does not reliably induce slower driving speeds.

The posted speed limit is set near the speed at which 85% of vehicles are traveling. The 85th percentile speed is considered the speed that is reasonable and prudent for a given roadway segment. To determine the 85th percentile speed, Caltrans conducts a "Traffic and Engineering Study" every 5-10 years. A roadway that has undergone physical changes, including the addition of traffic calming features, may also be studied to determine if the speed limit should be revised. If a slower 85th percentile speed exists, the posted speed limit may be lowered.

Main Street Design Speed

In California, most highway projects, including main street projects, are modifications of existing facilities. For the design of new highway segments, the HDM lists recommended design speeds. The selected design speed for a state facility establishes minimum geometric design elements such as sight distance and vertical and horizontal alignments. The HDM considers context when selecting appropriate design speeds in lower speed facilities: "highway context in terms of area place type, land use, types of users, etc. need to also be considered when determining the appropriate design speed in lower speed facilities." The HDM lists main streets as lower speed facilities in Table 101.2.

- California Vehicle Code 627 - Engineering and Traffic Surveys.
- Highway Design Manual (HDM), Chapter 100: Design Speed.
- Caltrans Traffic Operations website.

Above: A traffic calming project on State Route 299 in Weaverville improved livability by slowing traffic speeds through town. The project installed new crosswalks with aesthetic paving, bike lanes, sidewalks, curbs, gutters and native trees and grasses.

Top: A road diet project on State Route 35 (Sloat Boulevard) in San Francisco converted a traffic lane into a bike lane. Bottom: A four lane portion of State Route 227 in San Luis Obispo was reconfigured to create space for a center turn lane, center medians with pedestrian refuge areas and wider bike lanes. This photo shows the area before the city installed landscaping.

Road Diets/ Number of Traffic Lanes

A "road diet" consists of converting one or more traffic lanes into another use. Reallocating the number of traffic lanes is a direct way of providing space within a limited right of way for other roadway and roadside features such as bike lanes, median plantings, pedestrian crossing islands, transit-only lanes and sidewalks.

Research shows that implementing road diets can result in reduced driving speeds, improved mobility and access for a wider range of travelers, reduced collisions and improved main street livability. Research also shows that on streets with excess capacity or where left-turning traffic is directed to a two-way left-turn lane, road diets can have minimal effects on vehicle capacity (the number of motor vehicles that can be served per hour).

Lane reallocation decisions should be based on analyses of potential impacts to pedestrian, bicyclist, driver and transit rider mobility; vehicle congestion; traffic conflicts involving all travel modes; movement of freight; maintainability (particularly sweeping and snow removal); and adjacent land uses.

Since reallocation of roadway space is a design and operations decision with numerous associated impacts on a project, it is vital that discussion of the various options occurs early in the planning process and includes meaningful stakeholder involvement.

- HDM, Topic 102 - Design Capacity and Level of Service: Number of Traffic Lanes; Chapter 300 and Index 301.1: Lane width guidance.
- FHWA Proven Safety Countermeasure - Road Diet (Roadway Reconfiguration).
- The Transportation Research Board "Highway Capacity Manual" (HCM 2010) (Provides methods for sizing roadway facilities and evaluating trade-offs in allocating street right of way.)

Right: Five traffic lanes along State Route 299 in Willow Creek were reconfigured into two traffic lanes, a center turn lane and bike lanes in each direction. Livability was further improved by the addition of street trees, landscaping and marked crosswalks.

Main Street Traffic Lane Width

In lower speed environments (up to 40 miles per hour) such as along main streets, there may be opportunities to reduce lane width to improve the conditions for a full range of travelers. Appropriate traffic lane width is determined by vehicle speed, traffic volume and types of vehicles served along a main street. Lane width is also influenced by adjacent land uses, local terrain and the location of the lane within the larger roadway network.

Narrower traffic lanes shorten crossing distances for pedestrians and bicyclists and can provide space for roadway elements like medians, bike lanes, sidewalks, on-street parking, transit stops and landscaping. In some cases, reduced lane widths in main street environments can influence drivers to maintain slower vehicle speeds, especially when undertaken in combination with other traffic calming strategies.

The optimal allocation of space within the main street right of way will depend upon site specifics, community goals and user needs. System access for bicyclists, pedestrians and transit users should be evaluated alongside the needs of motorists. The operations and physical dimensions of cars, recreational vehicles, trucks and buses, the classification or use of the highway (whether a route is a designated truck route, for example) and target speeds, all influence the selection of the appropriate lane width. When considering use of narrower lane widths, it is also important to thoroughly evaluate how narrower lanes may affect vehicle separation and the functionality of utilities and drainage.

Two-Way-Left-Turn Lanes

Two-way-left-turn lanes remove left-turning vehicles and bicyclists from the traffic flow and provide a buffer between opposing directions of travel. This can reduce turning related conflicts as well as conflicts between opposing directions of traffic. Two-way-left-turn lanes are sometimes utilized as a traffic calming measure when they are used in conjunction with traffic lane width reductions or road diets.

Above: Raised medians can have traffic operational benefits, and with landscaping, they increase the aesthetic and environmental value of the roadway, such as is shown here on former State Route 275 in West Sacramento.

- HDM Topic 305 - Median Standards; Topic 902 - Highway Planting Standards and Guidelines.
- Encroachment Permits Manual.

Raised Median Islands

Raised median islands (raised medians) provide multiple benefits for travelers and the community. Raised medians can reduce traffic conflicts, provide pedestrians a crossing refuge, reduce the scale of the street and with trees and landscaping, improve the aesthetic and environmental value of the street. Raised medians may also be appropriate sites for storm water treatment facilities.

Raised medians help reduce conflicts between pedestrians and traffic by allowing pedestrians to cross only one direction of traffic at a time. In areas of limited roadway width, raised medians may be in competition with other desirable features such as bicycle lanes, sidewalks or sidewalk planting.

A raised median may be placed to divert all through traffic from side streets and all left-turn movements to the nearest signal or intersection where turns are permitted. Designers must conduct proper analysis to ensure that these intersections can handle the added turning movements. Circulation from the side streets may be affected; therefore bicyclist and pedestrian circulation needs and the impacts on local businesses and neighborhoods should be evaluated.

Features in the island that classify as a fixed object, such as a tree, boulder, bollard, or monument, must meet set back distances from the median curb face. There are also design standards for the placement of trees and landscaping to ensure that vegetation does not obstruct horizontal and vertical sight distances.

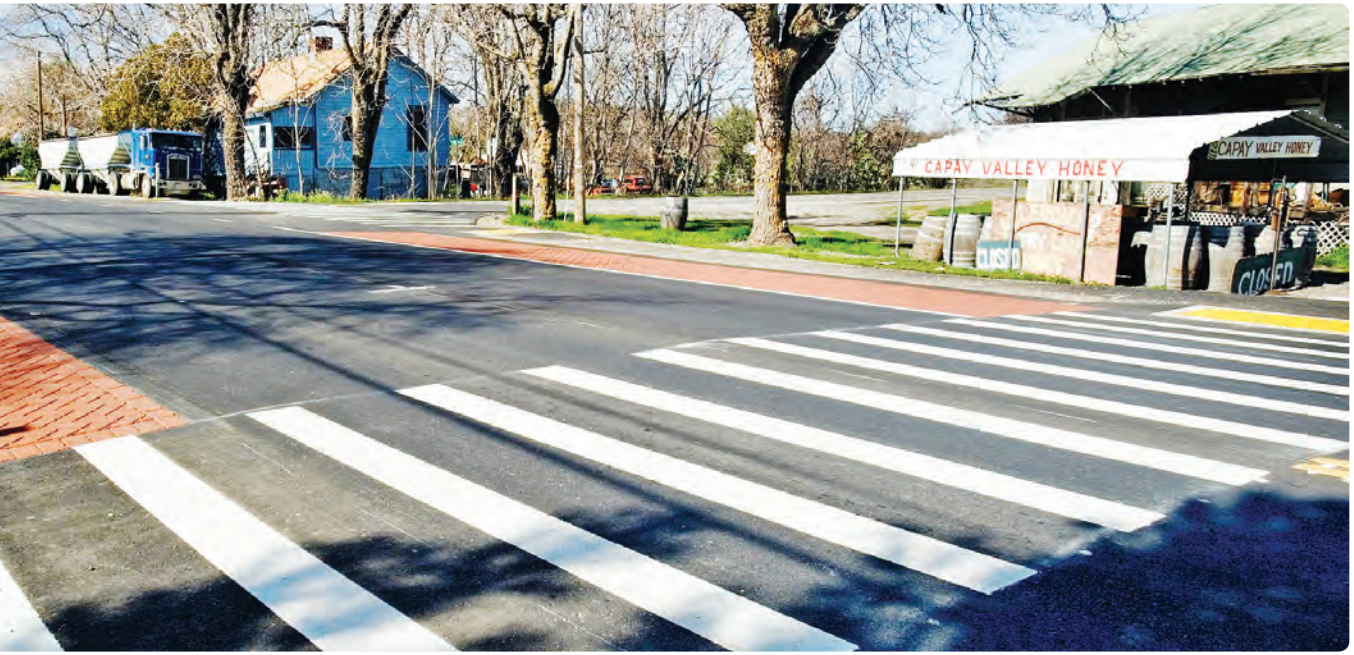
To facilitate safe and routine maintenance of raised medians, worker and equipment access needs should be evaluated and accommodated during design. Designs that minimize maintenance activities related to paving, landscaping and irrigation reduce worker exposure to traffic dangers. Raised median designs should also be evaluated for compatibility with snow removal activities and equipment needs.

Right: A raised median with a pedestrian crossing island increases pedestrian visibility and allows pedestrians to focus on one direction of traffic at a time on a city street in Oakland. Below: Pedestrian crossing islands can be installed as part of raised medians, or as independent pedestrian facilities, as shown on State Route 128 in Winters.

- HDM Topic 305 - Median Standards; Figure 405.4- Pedestrian Refuge Islands.
- FHWA Proven Safety Counter-measure: Medians and Pedestrian Crossing Islands in Urban and Suburban Areas.

Pedestrian Refuge Islands/ Pedestrian Crossing Islands

Pedestrian refuge islands or pedestrian crossing islands are raised islands that separate crossing pedestrians from traffic at intersections or mid-block locations. They allow pedestrians a sheltered place to stop at the midpoint of the roadway before crossing the rest of the street. They provide pedestrians a better view of oncoming traffic and increase the visibility of pedestrians to drivers. Where raised medians would otherwise hinder access to desirable pedestrian routes, a crossing island can help preserve pedestrian circulation.



Top: An urban mid-block crossing increases visibility for crossing pedestrians with a high visibility crosswalk and beacons, while the trees and landscaping provide environmental benefits. Bottom: This rural mid-block crossing includes a high visibility crosswalk on State Route 16 in Capay.

Mid-block Crossings

Mid-block crossings provide pedestrians additional opportunities to cross along streets with infrequent intersections, or where a direct route is needed to a popular destination (such as from a transit stop to a school or shopping center).

Locations for mid-block crossings and their physical configuration should be based on sound engineering judgment and analysis to provide maximum visibility of pedestrians to motorists; reasonable opportunities for pedestrians to cross; and reasonable disruption to the vehicle travel flow (to prevent traffic conflicts due to unexpected vehicle stopping).

Particular care should be given to mid-block crossings on roadways with two or more traffic lanes in one direction: a vehicle that is stopped for a pedestrian may prevent another driver, approaching in the next lane, from seeing the crossing pedestrian. Pedestrian visibility at mid-block crossings can be enhanced through the use of high visibility crosswalks, advance stop or yield markings and signals or beacons discussed in this chapter.

See California MUTCD for markings, signage, signals and beacons that can be used to increase visibility of pedestrians at mid-block crossings.

Curb Extensions or Bulbouts

Curb extensions are physical extensions of the sidewalk into the roadway where there is on-street parking. Curb extensions function as traffic calming elements and decrease the time and distance required for people to cross. Curb extensions increase the visibility of pedestrians to drivers and bicyclists and also give pedestrians a better view of oncoming traffic. Curb extensions can be placed at intersections or mid-block and they can provide additional space for street furniture, landscaping, aesthetic surface treatments and curb ramps.

Curb extensions should not extend into bike lanes and should enable trucks to turn without mounting the curb. They must be designed to allow for adequate drainage (to avoid water, ice, leaf and road debris buildup) and street sweeper accessibility. In areas of regular snowfall, bulbouts must be marked by objects visible to snowplow operators.

Bus bulbouts are discussed in the section "Designing for Connections to Transit."

- HDM, Section 303.4 - Curb Extensions.

Top left: Curb extensions may be placed at mid-block locations, as is shown on a city street in Oakland where a crosswalk connects to a pedestrian crossing island (see page 47 for a larger photo of this location). Bottom left: State Route 299 in Willow Creek accommodates curb extensions, bike lanes, upgraded sidewalks and landscaping. Right: A mid-block curb extension in Auburn on State Route 49/143 (High Street), provides space for decorative street lighting and a landscaped area that also treats storm water runoff.

Advance Stop or Yield Lines

Along multi-lane roads, a motor vehicle stopped for crossing pedestrians may prevent other drivers (approaching in an adjacent lane) from seeing the crossing pedestrians. Stop or yield lines that are placed in advance of crosswalks enable drivers in multiple lanes to see crossing pedestrians and also allow pedestrians greater visibility of oncoming traffic.

Crosswalk Markings

Pedestrians may legally cross at any intersection whether a marked crosswalk exists or not (except while a traffic signal is granting the right of way to other travelers, or in specific locations where signage indicates that pedestrians shall not cross). Crosswalk markings may be installed where they are needed to channel pedestrians into a preferred path at intersections. This is typically done when the intended course is not readily apparent or when, in the opinion of the engineer, the crosswalk would minimize pedestrian-auto conflicts.

Various crosswalk-marking patterns are illustrated in the California MUTCD. Research shows that "high visibility crosswalks" can have a positive effect on pedestrian and driver behavior at crossing locations.

Crosswalk markings are not required at every intersection and should not be used indiscriminately according to the California MUTCD. Current research shows that at marked crosswalks at uncontrolled intersections, crossing conditions can be improved with the installation of additional pedestrian safety features, such as signage, curb extensions or beacons.

- California MUTCD Chapter 3B – Pavement and Curb Markings; Figure 3B-19: Examples of Crosswalk Markings.

Top: A high visibility crosswalk in Santa Monica. Bottom: Traditional crosswalk markings on West Main Street (State Highways 70/89) in Quincy.

Evaluating Intersection Design

In some cases, main street transportation and livability conditions can be improved by modifying the physical configuration of an intersection or series of intersections. To select the best intersection design, an Intersection Control Evaluation (ICE) process exists to compare feasible alternatives.

The ICE process compares the performance and functionality of various intersection designs and also evaluates other potential traffic control strategies such as stop signs and traffic signals. Consideration is given to multimodal travel conditions at each specific intersection location, as well as how intersection design will affect the operation of adjacent intersections and conditions in the corridor as a whole.

Where a conventional intersection type is insufficient to address transportation needs, there are alternative intersection designs that may be considered. Among these are several alternative intersection designs that relocate left turn movements away from the major intersection. FHWA reports that "By removing one or more of the critical conflicting traffic maneuvers from the major intersection, fewer signal phases are required for signal operation. This can result in shorter signal cycle lengths, shorter delays and higher capacities compared to conventional intersections." More information is available in the "ICE Process Informational Guide," available on the Caltrans Traffic Operations website.

- Caltrans Traffic Operations Policy Directive 13-02: Intersection Control Evaluation.
- FHWA Alternative Intersections/Interchanges: Informational Report (AIIR).
- HDM Chapter 400: Intersections at Grade.
- The AASHTO Highway Safety Manual (Provides a methodology to compare the performance of various intersection designs.)

Above: A roundabout on State Highway 1, south of Fort Bragg. In similar locations, roundabouts have been shown to reduce fatal and injury collisions by about 75 percent on average.

Roundabouts

A roundabout is a circular intersection without traffic signals or stop signs, in which traffic flows counter-clockwise around a central island. As a 'yield control' intersection, approaching traffic yields and waits for a space in the circulating traffic flow before entering the circle.

In comparison with other conventional intersections, roundabouts have a proven record of reducing both the number and severity of traffic conflicts, due to reduced vehicle speeds and potential impact angles; common direction of travel; and fewer conflict points for all modes of travel.

Roundabouts may be considered on main streets when transportation-related needs can be met by modifying an intersection or series of intersections. Roundabouts can be evaluated as a strategy to provide

Left: A roundabout on State Route 89 in Truckee that includes transportation art, trees and site appropriate landscaping is designed to accommodate large vehicles such as trucks and buses.

traffic calming benefits and to reduce motor vehicle congestion. Multiple lanes and higher traffic speeds diminish the traffic calming benefits of roundabouts.

Roundabouts can sometimes be installed in conjunction with traffic lane reallocations, also known as "road diets." Signalized and stop-controlled intersections often require several approaching traffic lanes to accommodate queues of vehicles waiting at a red-light or stop sign. Roundabouts typically require fewer approaching lanes since lines of waiting vehicles and bicyclists do not accumulate; they need only to wait for a space in the traffic flow to move through the intersection. In some cases, reconfiguring a signalized or stop-controlled intersection into a roundabout intersection can provide an opportunity to convert excess traffic lanes into other uses such as bicycles lanes, wider sidewalks and/or landscaped areas. The "footprint" required for a roundabout at the point of intersection is larger than signalized or stop-controlled intersections.

Landscaping within the central island of the roundabout, in the pedestrian crossing islands (splitter islands), or along the approaching roads provides environmental, aesthetic and traveler safety benefits. Appropriate landscaping and aesthetic treatments in the central island should convey to travelers that they are not to pass through the central island, maintain safety setbacks, encourage pedestrians to cross only at designated crossing locations and aesthetically integrate the intersection into the surrounding area.

Roundabouts may have higher construction costs than other intersections but may also have lower life-cycle costs. Roundabouts often provide long-term fiscal benefits related to reduced congestion, reduced accident severity and the lack of traffic signals to install and maintain. See the "Traffic Operations Policy Directive 13-02: Intersection Control Evaluation" for guidance regarding the appropriate consideration and technical evaluation of roundabouts.

- National Cooperative Highway Research Program (NCHRP) Report 672- Roundabouts: An Informational Guide, Second Edition.
- FHWA Proven Safety Countermeasure- Roundabouts.
- HDM, Topic 613.5 - Specific Traffic Loading Considerations for Roundabouts.
- California MUTCD, Chapter 3C - Roundabout Markings.
- Caltrans Complete Intersections Guide, Chapter 8- Roundabouts.

Physical design considerations and the safety benefits of roundabouts are discussed extensively in: "Roundabouts: An Informational Guide, Second Edition." A general discussion of nonmotorized travelers at roundabouts is included here.

Top: A bicyclist takes the full lane of this landscaped roundabout on a Davis city street. Bottom: This roundabout on State Route 89 in Truckee includes trees, landscaping and splitter islands with clearly designated pedestrian crossing locations.

Pedestrians at Roundabouts

Roundabouts can reduce both the occurrence and severity of conflicts between pedestrians and vehicles due to fewer potential conflict points and reduced driving speeds. Traditional intersections have a greater number of potential conflict points due to turning traffic and traffic moving in different directions. Slower driving speeds and common direction of travel increases the number of vehicles and bicyclists yielding to pedestrians at single lane roundabouts.

Pedestrians travel through roundabout intersections at marked crosswalks that are set back from the entrance points of the circulatory traffic path. Setting the crosswalk back from the traffic entry point shortens both the distance of each crossing location and the length of time that pedestrians must spend in the crosswalk. This crosswalk placement also helps drivers and bicyclists first focus their attention on crossing pedestrians before evaluating the circulating traffic stream. Pedestrians are not permitted in the center of roundabouts located on State highways.

The installation of beacons and accessible pedestrian signals can also improve conditions for pedestrians at roundabouts. Accessible pedestrian signals are particularly valuable at multilane roundabouts where auditory traffic cues are difficult for pedestrians with sight impairments to discern. Beacons and signals are discussed in the following section.

Bicyclists at Roundabouts

Single-lane roundabouts can reduce the severity of conflicts between bicyclists and motor vehicles due primarily to the reduced speeds of motor vehicles. Depending upon personal comfort level, bicyclists may prefer to enter roundabouts as a vehicle, or they may use pedestrian crosswalks. Bike lanes are not placed within roundabouts since this would place bicyclists at the outer edge of circulating traffic which increases potential traffic conflicts between bicyclists and entering and exiting motor vehicles.

Signals and Beacons

This section provides a general discussion of signals and beacons that may be used at a variety of intersection types and pedestrian crossing locations. Thorough guidance regarding the appropriate application of various signals and beacons is located in the California MUTCD and on the Caltrans Traffic Operations website. Early project development discussions should address roles and responsibilities for maintenance activities and the evaluation of life-cycle costs associated with various signals and beacons.

Traffic Signals

Traffic signals control the movements of pedestrians and traffic. They assign the right of way to various traffic movements and influence traffic flow. Coordinated traffic signals can deter motorists from speeding by setting the green light timing to be consistent with a traffic flow that is moving at the speed limit. An engineering study of the site and traffic conditions determines whether installation of a traffic control signal is justified at any particular location. Poorly located traffic control signals can adversely affect vehicular, bicycle and pedestrian traffic flow and can result in unnecessary congestion.

Pedestrian Countdown Timers

Pedestrian countdown timers are incorporated into pedestrian signal heads and inform pedestrians of the number of seconds remaining to cross the street. They are required at all new signalized intersections and pedestrian crossings on the State Highway System. Countdown timers are especially valuable along busy or wide streets to prevent pedestrians from becoming stranded in the middle of the street when the signal changes.

- California MUTCD Chapter 4C - Traffic Control Signal Needs Studies; Chapter 4E: Pedestrian Control Features; Section 4D: Bicycle Signals.
- Traffic Operations Policy Directive 12-01: Pedestrian Walking Speed, APS And Countdown Timer Requirements At All New Signalized Crossings.
- California MUTCD Section 4D; Traffic Operations Policy Directive 09-06: Bicycle and Motorcycle Detection.

Leading Pedestrian Interval (LPI)

Traffic signal timing can be set so that pedestrians are allowed to begin crossing the street before parallel vehicles get a green light. This early walk signal, called a leading pedestrian interval, provides pedestrians several seconds to travel farther into the intersection where they are more visible to drivers and bicyclists. LPI may help reduce conflicts between pedestrians and turning traffic at intersections with high pedestrian volumes and high bicycle and vehicle turning volumes.

Accessible Pedestrian Signals (APS)

APS are devices that communicate pedestrian signal timing information in non-visual formats, such as audible tones, speech messages and/or vibrating surfaces. APS are required at all new signalized intersections and pedestrian crossings. APS are especially useful in locations where the auditory cues for sight impaired travelers may provide confusing information such as intersections where right turns are permitted on red, continuous right-turn movements, complex signal operations, multilane roundabouts, wide streets, or areas of low traffic volumes.

APS detectors may be activated by pedestrians or by passive detection devices (a feature that activates a pedestrian signal when a sensor detects a waiting pedestrian). Passive pedestrian detection can also allow the length of the walk signal to adjust to the pedestrian's actual walking speed across the intersection.

Right: A mid-block crossing controlled by RRFBs, in conjunction with warning signs, on Historic Route 40 (Russell Boulevard) in Davis.

Detection for Bicycles and Motorcycles at Traffic Signals

Bicycle and motorcycle detection technology allows a traffic signal to be activated when a sensor detects the presence of a waiting bicycle or motorcycle. Without bicycle and motorcycle detection, riders must either wait for a vehicle to arrive to trigger the signal, or they must push the pedestrian button. Bicycle and motorcycle detection is required on all new and modified approaches to traffic-actuated signals.

Bicycle Signals

A bicycle signal directs bicycle traffic through an intersection and may only be used in combination with an existing traffic signal. Bicycle signals may be used to address an identified safety or operational problem involving bicycles. The California MUTCD recommends that alternative means of addressing conflicts between bicycles and motor vehicles be considered before the installation of bicycle signals. Opportunities to improve bicycling conditions are discussed in the section "Design for Bicyclists."

Transit Signal Priority is discussed in the section "Connections to Transit."

Rectangular Rapid Flashing Beacons

Rectangular Rapid Flashing Beacons (RRFBs) utilize rapidly alternating flashing lights to alert drivers that they must yield to pedestrians in the crosswalk. RRFBs use high-intensity light-emitting diode (LED) lights and are used in conjunction with warning signs. The beacons are either activated manually by a push button or through the use of sensors that detect the presence of pedestrians waiting to cross (also known as passive pedestrian detection). The flashing pattern is irregular, similar to some emergency response vehicles. Research shows that traffic yields at a greater rate with the RRFBs compared to standard flashing beacons. RRFBs can be used on either two-lane or multi-lane roadways.

FHWA granted an "Interim Approval" for the optional use of the RRFB as a warning beacon to supplement standard pedestrian crossings or school crossing signs at crosswalks across uncontrolled approaches. Jurisdictions wishing to install RRFBs must comply with conditions outlined in the FHWA "Interim Approval" and must notify Caltrans of the RRFB location.

Flashing Beacons

Red flashing beacons can provide traffic control when used as an intersection control beacon. Yellow-flashing beacons are used as warning beacons. Some of the typical applications for flashing beacons include mid-block crosswalks, schools, fire stations and as supplements to warning and regulatory signs.

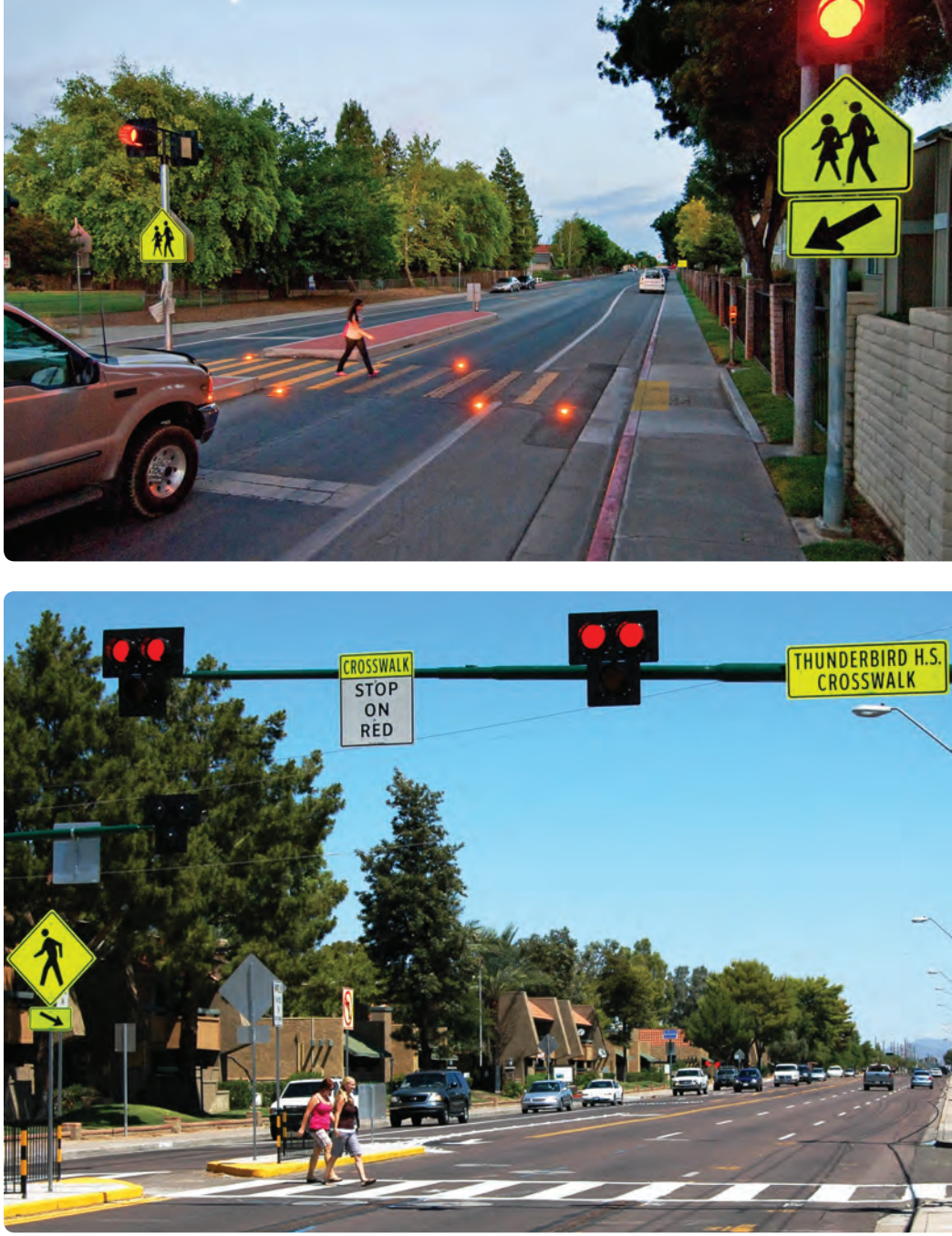
Pedestrian Hybrid Beacons

Pedestrian hybrid beacons are also known as "high intensity activated crosswalks" or by the acronym "HAWKs." Pedestrian hybrid beacons are activated by pedestrians using a push-button and are only used in conjunction with crosswalk markings. They are commonly used for mid-block crossings and in areas without pedestrian traffic volumes high enough to warrant the installation of a full traffic signal.

In-Roadway Lights

In-roadway lights are installed in the roadway surface to warn travelers that they will need to yield ahead to pedestrians in marked crosswalks at school or mid-block crossing locations, in advance of roundabouts or in other roadway situations involving pedestrian crossings. In-roadway lights may have notably higher maintenance costs than other devices such as RRFBs and may not be compatible with snow removal activities.

- FHWA Interim Approval for Optional Use of Rectangular Rapid Flashing Beacons (IA-11).
- FHWA Proven Safety Countermeasure - Pedestrian Hybrid Beacon.
- California MUTCD, Part 4 - Flashing Beacons, Pedestrian Hybrid Beacons and In-Roadway Lights.



Top: In-roadway lights and flashing beacons on a city street. Bottom: Pedestrian hybrid beacons on a city street.

Left: In Quincy, street trees and parked cars buffer pedestrians from traffic along West Main Street, State Route 70. Top right: State Route 16 in Esparto provides back-in angled parking. Bottom right: This photo illustrates the danger that opening car doors pose to bicyclists.

Motor Vehicle Parking

On-street parking may provide traffic calming benefits and can help support economic vitality for main street businesses. Parked cars buffer pedestrians and adjacent buildings from traffic. Parked vehicles must not obstruct a driver's clear line of sight at an intersection.

- HDM Topic 402.3 - On-Street Parking.
- California MUTCD, Part 3- Parking Space Markings.
- Caltrans Standard Plan "Accessible Parking, On-Street."
- The United States Access Board

In areas of limited roadway width, space for parking is often in competition with other main street features, such as wider pedestrian areas, bicycle facilities, raised medians and sidewalk landscaping and tree plantings.

Angled parking, either forward (nose-in) or reverse (back-in), may provide more spaces than parallel parking, but requires more space within the right of way than parallel parking. Back-in angled parking offers drivers better visibility of bicyclists and other traffic when they are exiting a parking space. Angled parking is most feasible when there is adequate space to allow vehicles to enter or exit the space without interfering with a bicycle lane, or the traveled way of the main street.

Traffic conflicts can be caused when automobile drivers or passengers open the doors of parked vehicles into the path of bicyclists. Bicyclists are at risk of injury if they strike the door and they risk being hit by a moving vehicle if they swerve to avoid the opening car door. Back-in angled parking helps minimize this traffic danger for bicyclists. Additional strategies for improving bicycling conditions near motor vehicle parking areas are listed in the "Design for Bicyclists" section.

On main streets, bicycle travel may occur in facilities designed specifically for bicycle travel or in traffic lanes shared with vehicles, as shown on these city streets in San Francisco.

Design for Bicyclists

The following section describes design options that facilitate comfortable bicycle travel on main streets. Bicyclists also benefit from many of the balanced roadway and intersection strategies discussed earlier in this chapter.

Main street as a travel route and as a destination in its own right, will attract bicyclists of diverse ages and abilities. Bicyclists may ride on main street to commute to work, connect to public transit, run errands, take local or long-distance recreational trips, and/or to stop and patronize main street businesses. Identifying these diverse travel needs may help evaluate which additional roadway or roadside features could help improve bicycling conditions on main street.

When evaluating how to improve bicycling conditions at a particular location, planners and designers should also consider that bicyclists possess diverse bicycling abilities and varying levels of comfort with riding close to motor vehicle traffic. Consideration should be given to the full range of novice and experienced riders, such as children who may ride alone or in groups to school, as well as confident bicycling commuters who may ride daily in all forms of weather. All bicyclists will value comfortable and efficient main street travel routes.

Shared Traffic Lanes

In some cases, main streets may be fully adequate for efficient bicycle travel, and additional signing and pavement markings for bicycle use may be unnecessary. Bicyclists may legally share main street traffic lanes with motor vehicles whether or not additional signs and pavement markings are present.

Left: Shared lane markings alert roadway users that both bicyclists and motorists have legal use of the full traffic lane. Right: Bike lanes such as this one along State Route 225 in Santa Barbara can encourage both experienced and novice riders to travel by bicycle.

Shared Lane Markings (Sharrows)

Shared Lane Markings are pavement markings that alert roadway users that both bicyclists and drivers may legally use the full traffic lane. They are used in lanes that are too narrow for a motor vehicle and a bicycle to travel side by side within the same lane. Shared lane markings alert road users of the likely location of bicyclists in the road. They mark the position in the lane where bicyclists can ride to avoid opening car doors where there is on-street parking. The absence of a shared lane marking does not preclude a bicyclist from legally taking the full lane.

A shared lane marking and the sign shown to the left, "Bicycles May Use Full Lane," may be used together or independently to communicate to motorists and bicyclists that a lane is too narrow for both modes to travel side by side.

Bike Lanes

Bike Lanes (Class II Bikeways) provide a striped lane for one-way bike travel on a street. Bike lanes are intended to delineate the right of way assigned to bicyclists and motorists and to provide for more predictable movements by each. Particularly on busy streets, bike lanes can add to the comfort of riders who prefer not to share traffic lanes with motor vehicles. In areas of limited roadway width, the addition of new bike lanes may require reallocating roadway space dedicated to traffic lanes, sidewalks, medians, landscaped areas or street-parking.

- California MUTCD, Part 9 - Traffic Control for Bicycle Facilities.
- HDM Chapters 300, 400 and throughout as appropriate: Bike lane guidance.

Above: Green paving enhances the visibility of bike lanes, as is shown in this portion of former State Route 275 in West Sacramento. Right: State Route 35 in San Francisco includes wide bike lanes adjacent to parked cars.

Green Colored Pavement for Bike Lanes

Green colored pavement may be installed within bicycle lanes as a supplement to other bike lane markings. The green color makes the bike lane more conspicuous to all travelers. The color may be used for the entire length or selected portions of the bicycle lane.

The FHWA cites positive operational effects of green colored pavement in bike lanes, such as "bicyclists positioning themselves more accurately as they travel across intersections and through conflict areas" and "motorists saying that the green colored pavement gives them an increased awareness that bicyclists might be present and where those bicyclists are likely to be positioned within the traveled way."

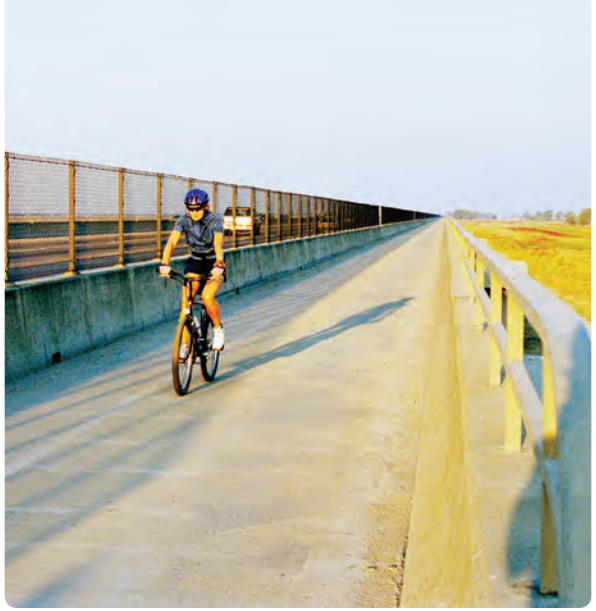
The FHWA issued an "Interim Approval for Green Colored Pavement for Bike Lanes" and lists the conditions of the interim approval on the MUTCD FHWA website. Maintenance requirements should be evaluated when considering the use of this treatment.

Bike Lanes and On-Street Parking

Bicyclists face hazards from motorists who are parking vehicles: they may be hit during the parking maneuver itself or by an opening vehicle door. On streets with parked vehicles, wider bike lanes allow bicyclists to avoid opening car doors.

Options for improving bicycling conditions near motor vehicle parking areas:

- Install wide bike lanes.
- Designate back-in angled parking instead of parallel or nose-in angled parking (which obscures bicyclists from a driver exiting a parking space).
- Minimize parallel parking lane width. This technique is best used in conjunction with widening the bike lane.
- Mark parallel parking spaces to help guide drivers closer to the curb.
- Place shared lane markings, where appropriate, to indicate the ideal lateral position that bicyclists should occupy in the traffic lane and to remind drivers to expect bicyclists.



Left: A bike lane sited to the left of the right turn lane along a city street in Cupertino. Middle: A bike path along I-80 provides a bicycling connection between Yolo and Sacramento counties. Right: A bike path in Redding runs parallel to State Route 44 and enables bicyclists to cross I-5 and the Sacramento River.

Bike Lanes at Intersections

To minimize conflicts between motor vehicles and bicyclists at right turn lanes, bike lanes are sited to the left of the turn lane. Where roadway width is insufficient to accommodate both a right turn lane and bike lane at an intersection, shared lane markings may be used.

Pavement markings may also be used to highlight where bicycles will be positioned within the roadway as they travel through the intersection or during left-hand turns.

Bike Routes

Bike Routes (Class III Bikeways) provide for shared use with pedestrian or motor vehicle traffic. Designation of bike routes should indicate to bicyclists that there are particular advantages to using these routes as compared with alternative routes. The HDM discourages the use of sidewalks as Class III bikeways.

Bike Paths

Bike Paths (Class I Bikeways) are paved off-street routes for the exclusive use of bicycles and pedestrians. Bike paths are commonly used to close gaps in bicycle travel created by barriers such as freeways or rivers. As a facility that may also serve pedestrians, bike paths must meet accessibility requirements, as stated in Caltrans Design Information Bulletin 82. Where regular pedestrian use of a bike path is anticipated, separate facilities for pedestrians can minimize conflicts.

Bike paths may provide vital connections between towns and main street locations. The HDM recommends against placing bike paths immediately adjacent to main streets.

Left: Providing bicycle parking ensures that bicyclists are able to stop and patronize local main street businesses. This Sacramento city street includes functional bike racks that also contribute to the street's aesthetic character.

Bike Parking

The HDM encourages the placement of bicycle parking near businesses, shopping and other locations. Providing bicycle parking encourages bicycle travel, and it can benefit the local economy by providing opportunities for bicyclists to secure their bikes while visiting main street businesses. Bicycle parking on sidewalks must not infringe upon the ADA requirements for pedestrian zones.

Signs for Bicycle Facilities

Signage related to bicycle travel can alert travelers to the presence of bicyclists and can alert bicyclists to specific travel conditions. Guide signs and plaques can also assist bicyclists in locating travel routes with the most optimal bicycling conditions.

- HDM, Chapter 1000 Bicycle Transportation Design, Chapter 300 Geometric Cross Section and throughout HDM topics where appropriate.
- California MUTCD Part 9 - Traffic Control For Bicycle Facilities; and Part 6 - Temporary Traffic Control.
- Caltrans Traffic Operations Policy Directive 11-01: Accommodating Bicyclists in Temporary Traffic Control Zones.

Bicycle Access During Construction

Bicycle access must be preserved during main street construction and maintenance activities. Temporary traffic control zones are required to provide continuity of bicycle travel around a closure.

Drainage Grates

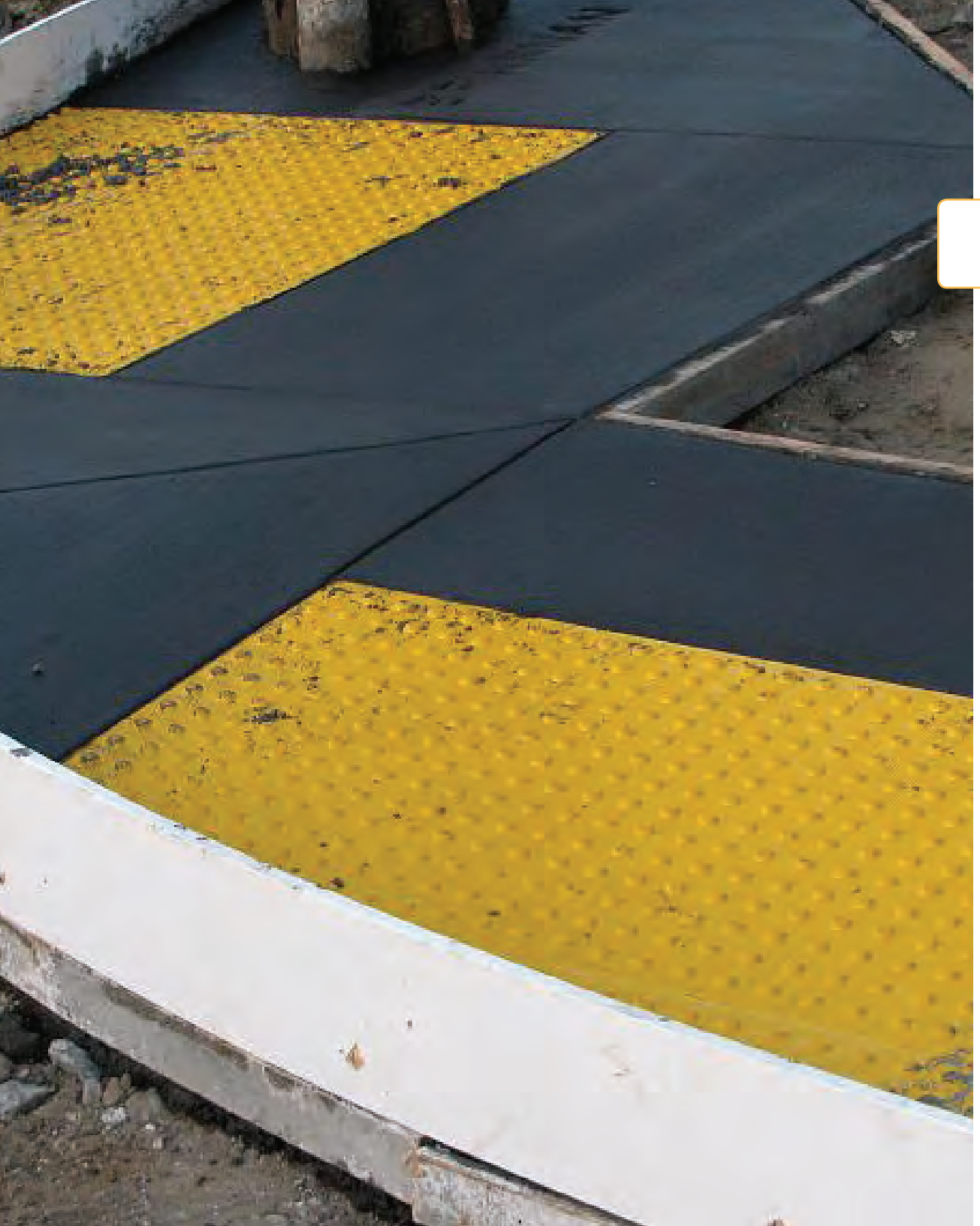
Proper positioning of roadway drainage grates or curb inlets is essential to avoid impediments to bicycle travel. Requirements for design and placement of grates are provided in HDM 837.2 and additional information is available in HDM Chapter 1000, Bikeway Planning and Design.

Design for the Pedestrian Realm

This section discusses features that can make the pedestrian realm an inviting and multifunctional public space. Pedestrians also benefit from the traffic calming and balanced roadway features discussed earlier in this chapter such as curb extensions, roundabouts, raised medians, pedestrian refuge islands, beacons and signals.

Well-designed pedestrian spaces are accessible to all ages and abilities and enable comfortable use of the space for daily life. Many of the activities that define a desirable community take place within the pedestrian realm, such as walking to local shops and restaurants, strolling with friends and pets and spontaneously meeting up with neighbors.

The aesthetic character and visual identity of a community is strongly associated with the quality of the pedestrian spaces. Tree-lined streets, public art, attractive landscaping and street furnishings that encourage people to pause and linger can draw people to main street as an inviting travel route and as an appealing destination.



Accessible Main Streets

Main streets are vital community routes and destinations that must be accessible to a full range of travelers. Sometimes design modifications to surface color, texture or layout can greatly improve the travel conditions for pedestrians with disabilities. Evaluating materials and design choices for their compatibility with the needs of a broad range of users may provide a higher degree of accessibility than the minimum design standards required by law or Caltrans policy. References for Caltrans standards and guidance; state and federal requirements; and best practice recommendations for accessibility are listed on the following page.

Left: Caltrans Design Information Bulletin 82 and Caltrans Standard Plans provide guidance on required curb ramps and detectable warning surfaces.

Main streets must provide access to pedestrians of all ages and abilities.

Americans with Disabilities Act (ADA) Design Guidance

- Caltrans Design Information Bulletin (DIB) 82.
- Caltrans Curb Ramp Scoping And Design Policy.
- HDM, Topic 105 - Pedestrian Facilities.
- Local Assistance Procedures Manual, Chapter 11.
- Complete Intersections Guide.
- California MUTCD.
- Caltrans 2010 Standard Specifications:
  - Section 73 - Concrete Curbs and Sidewalks.
- Caltrans Standard Plans:
  - Accessible Driveway
  - Curb Ramp
  - Curb Ramp and Island Passageway
  - Accessible Parking Off-Street
  - Accessible Parking On-Street
- FHWA Accessibility Resource Library.

Sidewalks

Sidewalks are important spaces within the public realm that contribute to pedestrian mobility, economic vitality, community life and neighborhood aesthetics. Sidewalks that connect people to important destinations and provide space for daily activities—like walking side by side, waiting comfortably for transit, resting in the shade of street trees and pausing to peer in shop windows—can help enhance community livability.

Wide sidewalks offer a pleasant pedestrian experience and should at least be wide enough to allow pedestrians to walk side by side or pass comfortably. More width is desirable to accommodate high pedestrian volumes, public transit shelters, street furniture, landscaping, street trees and other outdoor uses. In areas of limited roadway width, installing or widening sidewalks may require reallocating roadway space dedicated to traffic lanes, bike lanes, medians, landscaped areas or street-parking.

All sidewalks and curb ramps must be designed in compliance with state and federal accessibility standards. Minimum sidewalk clear widths should be free of utilities, furniture, signs and all other obstructions. Pedestrian access must be preserved during main street construction and maintenance activities. Temporary traffic control zones are required to provide continuity of pedestrian travel around a road or sidewalk closure.

Top left: A successful retail corridor of a Santa Monica city street provides wide sidewalks to accommodate a large number of pedestrians. Bottom left: Sidewalks can incorporate aesthetic treatments as shown in this sidewalk in Redding. Middle and right: Sidewalks along Santa Monica Boulevard (former State Route 2) serve as a primary pedestrian travel route while also facilitating social interaction.

- HDM Topic 105 - Pedestrian Facilities.

Pavement Treatments at Intersections

Pavement that is textured, stamped or colored can help emphasize an intersection, pedestrian crossing or sometimes an entire street. Aesthetic paving increases the visual appeal of the street and can help communicate that the roadway is a space that is shared by multiple modes of travel.

Aesthetic paving in crossing areas should provide a comfortable surface for walking and cycling and must comply with all ADA legal requirements. Materials should be selected with sensitivity towards the amount of vibration exposure that the surface generates for wheelchair users.

The life-cycle cost analyses of aesthetic paving treatments should include evaluation of the long-term maintenance expenditures over the life of the material. Some paving treatments have higher maintenance requirements than others. Stamped concrete and asphalt treatments are less expensive to install and easier to maintain than bricks or unit pavers.

Textured and colored surfaces must meet the criteria specified in the California MUTCD. All paving must comply with accessibility requirements and must meet applicable structural section requirements as specified by the Caltrans District Materials Engineer.

Top: This stamped asphalt crosswalk on former State Route 275 in West Sacramento is colored to resemble brick pavers. Bottom left: Tiles for a thermoplastic crosswalk pattern being applied on State Route 255 in Arcata (shown before installation of crosswalk pavement markings). Bottom right: Asphalt inlaid with a thermoplastic material on a city street in Oakland.

California MUTCD Chapter 3B – Pavement and Curb Markings; Chapter 3G - Colored Pavements.

Street Landscaping

Street landscaping makes communities more attractive and can contribute to a more livable and environmentally sustainable public space. Well-designed landscaping along the roadway or in medians can increase driver awareness of the immediate environment as a shared space, which can influence drivers to slow down.

Sidewalk and median landscaping can provide seasonal beauty, an inviting atmosphere and screening of unattractive elements such as utilities. Main street projects may provide locations for local agencies, municipalities or civic organizations to plant and maintain landscaped areas.

Landscaping can enhance the beauty of main street as illustrated in these photos of Santa Barbara city streets. Top: Landscaping provides seasonal interest and color while complementing local architectural styles and aesthetics. Bottom: A local business planted and maintains attractive landscaping to improve the aesthetics of the establishment and the street as a whole.

Street Trees

Trees are a valuable public asset that make main streets beautiful, welcoming and comfortable. Street trees add an attractive canopy overhead and can increase pedestrian comfort where shade or protection from the wind is desirable.

Tree-lined streets contribute to a community's distinctive identity, economic vitality, environmental health and seasonal beauty. Numerous studies report that trees notably increase property values and the appeal of shopping areas. Research also shows that respondents associate tree-lined streets with stable, valuable and well cared-for neighborhoods.

The species characteristics, growth habits and mature size are important to consider when selecting street trees and other landscape plantings. Appropriate trees are adapted to the local climate and environment; fit the site at mature size; and have root zones that are appropriate for the local conditions and proximity to pavement. Although all planted areas require regular maintenance, proper selection of trees and adequately sized tree wells can reduce maintenance expenditures and increase safety for highway users and workers.

Safety, sight distance standards, utility locations, environmental needs, soil conditions and maintainability are vital concerns when establishing the locations and species selection for tree plantings along main streets. Tree siting must conform to the Caltrans minimum setback requirements for clear recovery zones and sight distances as listed in the HDM.

- HDM, Topic 902 - Planting Guidelines.
- Encroachment Permits Manual: Chapter 500.
- Caltrans Landscape Architecture website.

The section **"Trees Benefit the Environment"** in the next chapter discusses environmental benefits of trees and urban forests. The **"Additional Resources"** page at the end of this chapter lists additional planting and tree selection guidance.

Top: Trees along Historic Route 40 (Russell Boulevard) in Davis provide seasonal interest and help beautify a major corridor through the city. Bottom: Street trees on State Route 75 (Orange Avenue) in Coronado beautify the street and provide shade for waiting transit riders.

Decorative lighting on U.S. Route 395 (top right) in Independence and Park Street in Alameda (top left). Photos on the bottom left show lighting and banners along city streets.

Banners and Decorations

Caltrans issues permits for the temporary placement of banners, decorations and signing for events sponsored by local agencies and nonprofit organizations over and along main streets. Permanent overhead signs or arches may not be erected over any State highway.

Street Lighting

Decorative lighting fixtures along main streets can enhance a town's unique sense of place, local aesthetics and historic character.

Caltrans provides street lighting for safety as warranted in the Caltrans "Traffic Manual," but does not install or maintain decorative lighting. It is the local agency's responsibility to secure funding for the purchase, installation, operation and maintenance of decorative main street lighting.

Decorative lighting fixtures must meet current federal and state safety standards. Poles and signal controller boxes must be located in compliance with all accessibility requirements and must meet setbacks. A Maintenance Agreement is also required.

- Signal, Lighting and Electrical Systems Design Guide.
- Encroachment Permits Manual, Chapter 500 (Section 501- Banners and Decorations; Section 515- Signals and Lighting).

Right: These city streets in Alameda and Los Angeles (far right) include street furnishings that help create a comfortable and multi-functional pedestrian space.

Street Furnishings

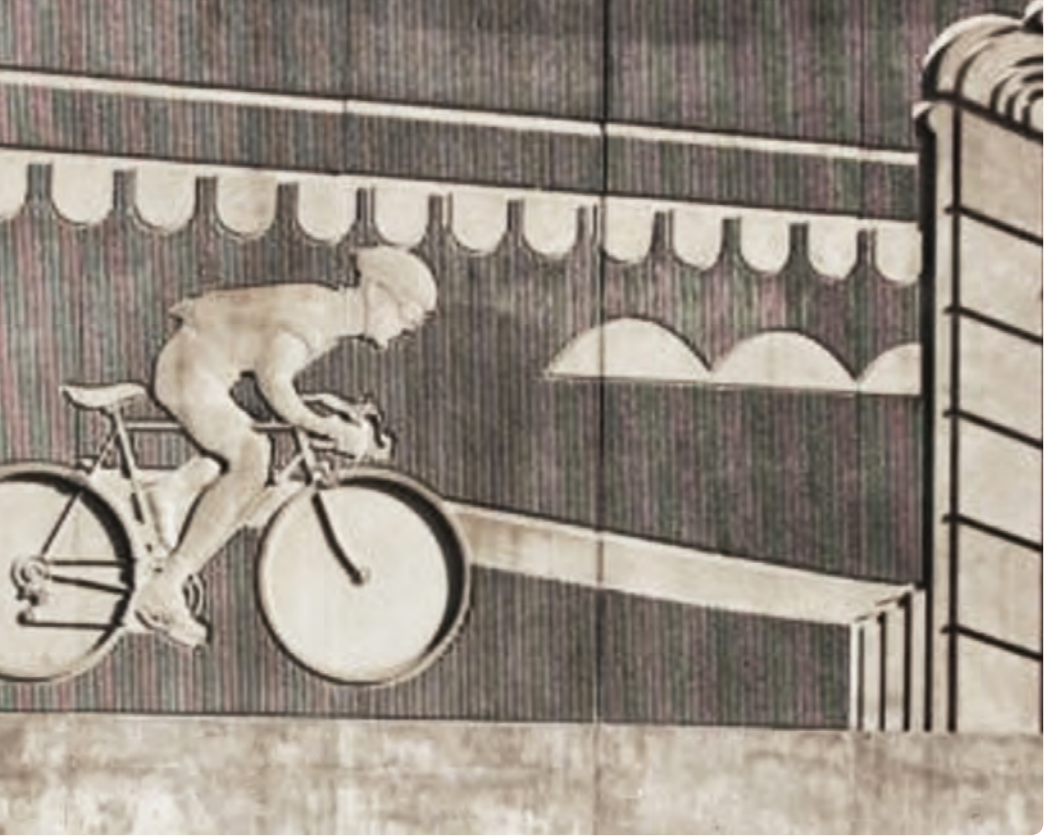
Street furniture can add to community livability by making the street a more comfortable, functional and aesthetically appealing place for travelers. The presence of street furniture enhances public awareness of multimodal travelers, and can encourage people to stop and visit local businesses and community centers. To create a more livable environment, a main street may include places to sit, such as benches, low walls, planter edges or wide steps.

All furnishings and their placement must meet ADA requirements. To provide an unobstructed area for pedestrians, the HDM also provides minimum horizontal clearances for objects located on, or adjacent to, sidewalks. Bollards must be tall enough so they do not create a tripping hazard to pedestrians.

California State Law (California Streets and Highways Code - Section 731) prohibits tables for dining within Caltrans right of way except under a special event permit or in areas where state property is relinquished to a local municipality.

Street furnishings can include:

- Benches
- Bike Racks
- Planters
- Tree Grates
- Newspaper Stands
- Way-finding Signage
- Transit Shelters and Signage
- Trash and Recycling Receptacles
- Water Fountains
- Bollards
- Decorative Street Lighting



Transportation Art

Transportation art can contribute to a community's livability goals of creating a unique character or sense of place by artistically reflecting local aesthetic, cultural, civic or environmental values.

Caltrans administers the Transportation Art Program, to encourage others to use its facilities, structures and right of way spaces for creative expression through the visual arts. Well-conceived art forms, properly located, can enhance the experiences of those using transportation facilities and enrich the environment of neighboring communities. Placement of artwork is conditional on appropriate Maintenance Agreements and is restricted to areas where maintenance can be performed safely.

Community Identification

Artistic portrayals of community identity located on required engineered highway features, such as walls and bridges, are coordinated through the Caltrans Community Identification Program. Community Identifiers are typically provided and maintained by a local agency and may include text and visual portrayals of local history, resources or other defining characteristics. Unlike transportation art, community identification is located on a required engineered highway feature and may include text.

Top left: Engineered walls along Route 101 in San Rafael provide space for artistic Community Identification. Bottom left: Aesthetic treatments, such as this pedestrian paving pattern in Redding, do not require participation in the Caltrans Transportation Art Program.

Gateway Monuments

A gateway monument is defined as any non-required freestanding structure or sign which communicates the name of the city, county, or township. Gateway monuments are solely planned, designed, funded, constructed and maintained by the local community. Gateway monuments are also a proven traffic calming measure by signaling to drivers that they are entering a community center which likely requires slower driving speeds.

- Project Development Procedures Manual, Chapter 29 and Caltrans Landscape Architecture Program website: Transportation Art, Community Identification and Gateway Monuments Programs.
- The Encroachment Permits Manual.
- HDM Index 901.1 -Landscape Architecture Program.

All costs, including labor, materials, equipment and supplies for design, engineering, testing, construction, installation, maintenance and removal of transportation art, community identifiers and gateway monuments are the responsibility of the local agency or municipality.

Above: State Route 61/112 (Davis Street) in San Leandro.

Top: This bus rapid transit stop in San Diego offers passengers a covered shelter, marked crosswalk and arrival time signage. Bottom: Even where main streets do not include transit services such as rail, they may be planned and designed to improve access to a nearby transit service.

Connections to Public Transit

Public transit is a vital transportation service that helps connect main street travelers to their local community and to other regions. Appropriately designed transit facilities can increase rider access and encourage transit use. Opportunities to improve pedestrian, bicyclist and motorist access to transit, or to include transit facilities on main street projects should be initiated during the project planning phase.

Transit vehicles may travel on and across main streets; therefore, main street designs must accommodate the size and maneuverability of applicable transit vehicles. Transit shelters and facilities must be located to provide efficient pedestrian access to the facility and should not obstruct the travel path of pedestrians that are not using public transit. Additional main street features that can be used to support public transit are listed on the next page.

Transit along main streets may include a wide range of types: motorbuses, trolley buses, Bus Rapid Transit (BRT), light rail trains, commuter rail trains, van pools, automated guideways and demand responsive vehicles. Funding for construction and maintenance of transit facilities may be provided solely by one agency or by a combination of local, state and federal sources. Early communication between agencies and the drafting of applicable agreements is essential.

Transit design standards can be found in the HDM and the AASHTO publications: “A Policy on Geometric Design of Highways and Streets” and “Guide for Geometric Design of Transit Facilities on Highways and Streets.”

Main street features that can be used to support public transit include:

- Transit-only lanes which segregate transit vehicles from the rest of the traffic, facilitating efficient and consistent service.
- Curb-side stops or in-lane stops.
- Bus bulbs, which are longer than 25 feet and facilitate passenger loading.
- Bus bays, which are indentations in the curb, allowing a bus to stop completely outside of the traveled way.
- Transit stops for bus and train loading at intersections or mid-block locations. Transit stops enable passengers to wait for transit vehicles without interfering with pedestrians traveling along the sidewalk. Locating transit stops just after intersections allows pedestrians to cross the street behind transit vehicles, allowing transit vehicles to resume travel more efficiently.
- Mixed flow or bus-only turn lanes for right and left turns, which allow for efficient turning movements for buses.
- Transit stop amenities such as shelters, shade trees, secure bicycle parking facilities, benches, lighting, trash receptacles, telephones and signage related to schedule and route information.
- Transit signal priority (TSP) which extends or advances the green light for transit vehicles at signalized intersections to improve the consistent flow of transit along a route. Prioritizing transit travel through intersections, within the established signal cycle, improves travel times for transit while minimally impacting cross-traffic and pedestrians. The intent of TSP is to reduce transit schedule delays by minimizing wait times at intersections. More reliable transit schedules and faster travel times encourage ridership and make transit services more cost efficient by reducing transit vehicle fuel consumption.
- Queue bypass lanes (sometimes called queue jump lanes) which allow buses to avoid long queues of vehicles at signalized intersections. A short bus-only lane, coupled with a bus-activated advance green phase, enables buses to travel quickly and reliably. The queue bypass benefits bus flow where it is not practical to provide a bus-only lane.

Top: A bus bay on former State Route 275 enables buses to vacate the traffic lane during passenger loading. Bottom: A transit shelter on a San Francisco city street provides time and route information.

Top: New products are subjected to rigorous testing and evaluation, including crash-testing, when applicable. Bottom: The bike box is a traffic control device that is currently undergoing evaluation through the FHWA's experimental process. Bike boxes allow bicyclists to move in front of waiting vehicles at red lights where they are more visible to motorists.

Innovative Devices and Products

Construction Evaluated Program for Experimental Features

This program evaluates the constructability and performance of experimental features on transportation facilities. Materials, processes, methods, equipment items, traffic operational devices or other features that are not currently accepted for use on Caltrans right of way may be eligible for evaluation under this program.

Once the FHWA approves a Construction Evaluated Work Plan (CEWP), Caltrans can begin evaluating the performance of the experimental feature over a three to five-year period. If the experimental feature performs well and field tests prove satisfactory, the feature may be approved for use. More information is available on the Caltrans Office of Resource Conservation website.

Federal Highway Administration (FHWA) Experimental Process

The FHWA administers an experimental process for evaluating new traffic control devices or alternative applications of existing devices that are not compliant with or not included in the "Manual on Uniform Traffic Control Devices" (MUTCD). More information is available on the MUTCD website.

New Traffic Control Devices

Traffic control devices recommended by the California Traffic Control Devices Committee (CTCDC) are eligible for use on State highway main streets. The CTCDC includes representatives from Caltrans, the League of California Cities, the County Supervisors Association, two auto clubs, two members representing non-motorized users of the highway system and the California Highway Patrol.

The CTCDC has a process for requesting that a new traffic control device be accepted for experimental use. Devices accepted for experimental use are monitored and evaluated for traffic and safety impacts. More information is available on the CTCDC website.

New Products

Caltrans has a formal process for evaluating new products for use in the State's transportation system. All new products are evaluated on the basis of need, performance, cost-competitiveness and compliance with health, safety and environmental regulations. New products must be commercially available. More information is available on the Caltrans Materials Engineering and Testing Services website.

Caltrans Resources

DIVISION OF DESIGN
http://www.dot.ca.gov/hq/oppd/index.htm

Accessibility Design
http://www.dot.ca.gov/hq/oppd/access/access.htm

Construction Evaluated Program for Experimental Features
http://www.dot.ca.gov/hq/oppd/rescons/guidelines.htm

District Liaisons
http://www.dot.ca.gov/hq/oppd/liaison/liaison.htm

Highway Design Manual (HDM)
http://www.dot.ca.gov/hq/oppd/hdm/hdmtoc.htm

Landscape Architecture Program
www.dot.ca.gov/hq/LandArch/

Community Identification - Guidelines
http://www.dot.ca.gov/hq/LandArch/community_id/index.htm

Gateway Monument Demonstration Program
http://www.dot.ca.gov/hq/LandArch/gateway/

Scenic Highway Program
http://www.dot.ca.gov/hq/LandArch/scenic_highways/scenic_hwy.htm

Transportation Art
http://www.dot.ca.gov/hq/LandArch/transart/index.htm

Project Development Procedures Manual (PDPM)
http://www.dot.ca.gov/hq/oppd/pdpm/pdpmn.htm

Roundabout Intersections
http://www.dot.ca.gov/hq/oppd/roundabt/index.htm

DIVISION OF TRANSPORTATION PLANNING
www.dot.ca.gov/hq/tpp/

Caltrans Bicycle and Pedestrian Program Contacts
http://www.dot.ca.gov/hq/tpp/offices/bike/contacts.html

DIVISION OF TRAFFIC OPERATIONS
http://www.dot.ca.gov/hq/traffops/

California Manual on Uniform Traffic Control Devices
http://www.dot.ca.gov/hq/traffops/signtech/mutcdsupp/pdf/camutcd2012/Part0.pdf

California Traffic Control Devices Committee
http://www.dot.ca.gov/hq/traffops/signtech/newtech/index.htm

Complete Intersections Guide
http://www.dot.ca.gov/hq/traffops/survey/pedestrian/

District Bicycle and Pedestrian Coordinators
http://www.dot.ca.gov/hq/traffops/survey/pedestrian/District-Bicycle-and-Pedestrian-Coordinators.pdf

Encroachment Permits Manual
http://www.dot.ca.gov/hq/traffops/developserv/permits/encroachment_permits_manual/index.html

Intersection Control Evaluation (ICE)
http://www.dot.ca.gov/hq/traffops/liaisons/ice.html

Pedestrian Safety Resources
http://www.dot.ca.gov/hq/traffops/survey/pedestrian/

Traffic Manual
http://www.dot.ca.gov/hq/traffops/signtech/signdel/trafficmanual-current.htm

Traffic Operations Policies and Directives
http://www.dot.ca.gov/hq/traffops/signtech/signdel/policy.htm

DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION
http://www.dot.ca.gov/research/

Additional Resources

All information provided by sources external to Caltrans must be evaluated for consistency with Caltrans policies and guidance.

AASHTO - A Policy on Geometric Design of Highways and Streets
Commonly referred to as the "Green Book," contains the current design research and practices for highway and street geometric design.
https://bookstore.transportation.org/collection_detail.aspx?id=110

AASHTO - Guide for the Planning, Design and Operation of Pedestrian Facilities
Guidance regarding pedestrian facilities on streets and highways.
https://bookstore.transportation.org/item_details.aspx?id=119

AASHTO - Guide for the Development of Bicycle Facilities
This 4th edition discusses strategies for accommodating bicycle travel. Some suggested minimum dimensions are provided.
https://bookstore.transportation.org/item_details.aspx?id=1943

AASHTO - Highway Safety Manual (HSM)
The HSM introduces an approach for evaluating the safety impacts of various design features, including those intended to improve the level of service for multimodal users, such as raised medians and road diets. The HSM outlines a predictive method to estimate crash frequency and severity to make informed safety decisions about a project.
www.highwaysafetymanual.org/

Bicycle Parking Guidelines, 2nd Edition
A basic guide for the selection and placement of bicycle parking facilities from the Association of Pedestrian and Bicycle Professionals.
http://www.apbp.org/?page=publications

Federal Highway Administration (FHWA) Accessibility Resource Library
http://www.fhwa.dot.gov/accessibility/

FHWA Experimental Process
http://mutcd.fhwa.dot.gov/condexper.htm

FHWA Interim Approvals
This website lists current interim approvals for new traffic control devices, revised applications of an existing traffic control device, or a provision not specifically described in the MUTCD.
http://mutcd.fhwa.dot.gov/res-interim_approvals.htm

FHWA - Guidance Memorandum on Promoting the Implementation of Proven Safety Countermeasures January 2012.
http://safety.fhwa.dot.gov/provencountermeasures/pc_memo.htm

FHWA - Speed Concepts: Informational Guide
This guide discusses various speed concepts including designated design speed, operating speed, speed limit and inferred design speed.
http://safety.fhwa.dot.gov/speedmgt/ref_mats/fhwasa10001/#c7.4

Model Design Manual for Living Streets
This guide discusses designing streets to balance the needs of multimodal travelers; and addresses features that make streets beautiful, economically vibrant and environmentally sustainable.
http://www.modelstreetdesignmanual.com/

NCHRP Roundabouts: An Informational Guide, Second Edition
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_672.pdf

Pedestrian and Bicycle Information Center
A resource for information about pedestrian and bicycle travel.
http://www.pedbikeinfo.org/index.cfm

Transportation Research Board (TRB) Highway Capacity Manual (HCM 2010)
Sizing roadway facilities and evaluating trade-offs in allocating street right of way among travel modes.
http://www.trb.org/Main/Blurbs/164718.aspx

Additional Planting Resources

"Redesigning the Urban Forest from the Ground Below: A New Approach to Specifying Adequate Soil Volumes for Street Trees"
Provides a methodology for sizing a tree pit based on a tree's daily expected water requirements. Also covers other planting strategies such as the use of interconnected tree pits and planning underground "break out" zones for roots. (By Lindsay, P. and Bassuk, N. Arboriculture Journal AB Academic Publishers, Vol 16; 1992.)
http://www.hort.cornell.edu/uhi/research/subject.htm

American Society of Landscape Architects (ASLA): "The Great Soil Debate: Understanding Competing Approaches to Soil Design."
Information about engineered soil, structural cells and blended soils (which contain topsoil, sand and compost) that can improve planting conditions and overall lifespan for trees and vegetation.
http://www.asla.org/uploadedFiles/CMS/Resources/22407_MoylesChris.pdf

California Department of Forestry and Fire Protection's Urban Forestry Program (Cal Fire)
Cal Fire promotes the development of sustainable urban and community forests in California. Cal Fire is a source of potential grants for urban and community forestry projects and provides technical guidance such as "Tree Growing, Buying and Care Guidelines."
http://calfire.ca.gov/

SelecTree: A Tree Selection Guide
SelecTree is an interactive program that identifies site appropriate trees based on characteristics such as mature height; proximity to pavement, structures and utilities; water and temperature requirements; fire safety; allergen potential; maintenance requirements and other issues. SelecTree is maintained by the Urban Forest Ecosystems Institute at Cal Poly State University, San Luis Obispo.
http://selectree.calpoly.edu/

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47/ State Route 128: Eric Fredericks; Flickr CCL

Oakland City Street: Lara Justine; Flickr CCL

48/ Landscaped median: Eric Fredericks; Flickr CCL

49/ State Route 49/143 (High Street):City of Auburn.

50/ Santa Monica pedestrian: Lara Justine; Flickr CCL

51/ Truckee Roundabout: Lara Justine; Flickr CCL

53/ Roundabouts in Davis and Truckee: Lara Justine; Flickr CCL

55/ RRFB's in Davis: Lara Justine; Flickr CCL

56/ Pedestrian hybrid beacon: Pedestrian and Bicycle Information Center Image Library; Mike Cynecki

57/ State Route 16 in Esparto: Eric Fredericks

Door zone: VinnyR; Wikipedia Public Domain.

58/ Bicyclist photos: San Francisco Bicycle Coalition; Flickr CCL

59/ Sharrow: SDOT (Allie Gerlach); Flickr CCL

60/ State Route 35 (Sloat Blvd.): SFBike; Flickr CCL

61/ Cupertino bike lane: Richard Masoner; Flickr CCL

62/ Sacramento Bike Parking: Lara Justine; Flickr CCL

63/ City Street: La Citta Vita; Flickr CCL

64/ Curb construction with detectable warning surface: Steven Damron; Flickr CCL

65/ Pedestrian on bench: Pedestrian and Bicycle Information Center Image Library; Dan Burden

Elk Grove accessible crossing: Eric Fredericks; Flickr CCL

66/ Top left pedestrian photo: Eric Fredericks;Flickr CCL

Middle and right pedestrian photos: Lara Justine; Flickr CCL

67/ Multi-color decorative paving in crosswalk: Deb Roby; Flickr CCL

68/ Santa Barbara city streets: Lara Justine; Flickr CCL

69/ State Route 75: Ryan Snyder

Davis city street: Lara Justine; Flickr CCL

70/ NOHO Banner: VMiramontes; Flickr CCL

71/ Alameda, Park Street: Lara Justine; Flickr CCL

Transit shelter Santa Monica: VXLA; Flickr CCL

74/ Caltrans sponsored Amtrak train: CaliforniaRailFan101; Permission granted by photographer via Flickr.

75/ Transit shelter: TrackTwentyNine; Flickr CCL

79/ State Route 16: Eric Fredericks

4 Sustainable Main Streets

Sustainable main streets are designed to minimize negative impacts on the environment and to maximize the positive contributions that the roadway and associated facilities can make to natural systems.

Multimodal main streets promote sustainability by providing the option to choose a travel mode that reduces pollution, greenhouse gas emissions and fossil fuel consumption, and they may also include active transportation benefits. This chapter illustrates how specific built roadway and roadside design features can contribute to sustainability.

Top: Landscaped areas can be designed to incorporate storm water treatment strategies, as shown here on State Route 123 (San Pablo Avenue) in El Cerrito and on State Route 49/193 (High Street) in Auburn (bottom).

Chapter 2
includes discussion of

Maintainability, Maintenance Agreements, Relinquishments and Cooperative Agreements

that may need to be addressed prior to the installation and maintenance of some of the features included in this chapter.

Some of the features listed in this section are variations on standard roadway and roadside features and may require additional design development and review in order to receive approval to implement.

Caltrans professionals can help identify how to best tailor sustainability features to fit local conditions.

Sustainable roadway and roadside design features:

- Minimize detrimental impacts to air, water and soil quality
- Minimize waste and hazardous substances
- Use materials and resources efficiently
- Promote energy efficiency
- Conserve natural resources such as water, soil and native vegetation
- Protect natural ecosystems
- Enhance public health and quality of life
- Enable fiscal sustainability by considering life-cycle costs

Main streets can be built and operated with sustainability principles through judicious selection of construction techniques and building materials and by creating roadside features that contribute to ecological health, such as landscaped areas that also function as storm water treatment facilities.

Storm Water Quality

Precipitation that falls during storm events can collect pollutants that may negatively affect aquatic ecosystems. Another environmental concern related to storm water is that impermeable surfaces, such as pavement and rooftops, do not allow precipitation to percolate back into the soil, which can increase the speed and volume of storm water entering downstream water bodies. An increased volume and velocity of water can cause erosion significant enough to damage the physical and ecological functioning of a region's hydrologic system.

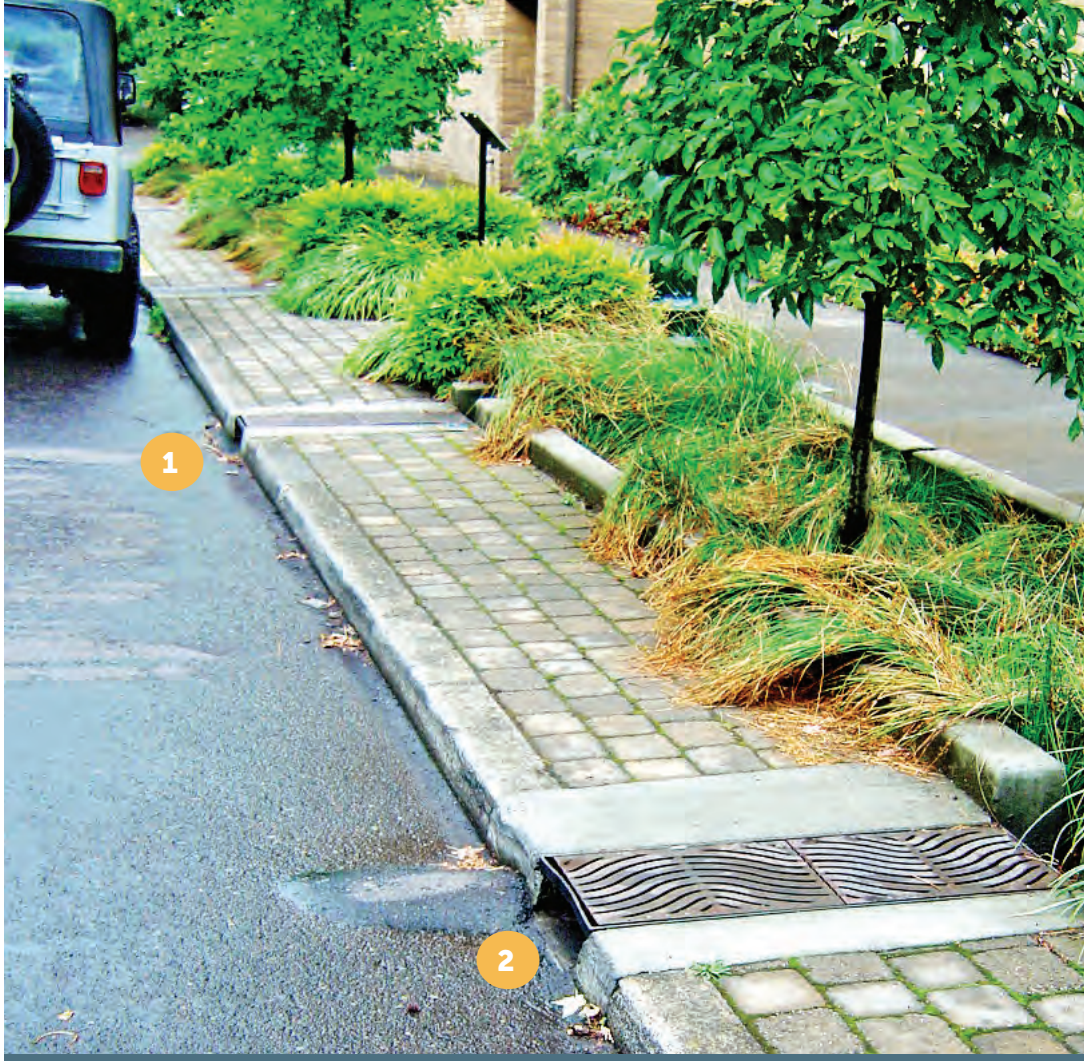
More information is available on the **Caltrans Office of Storm Water Management -Design** website.

Many projects are required to improve storm water quality by removing pollutants and, in some cases, regulating the discharge velocity and volume of runoff. Identifying the pollutants of concern in the receiving water body and determining the space available for storm water treatment will determine which water management strategies are best suited to a particular site.

Low Impact Development

Within storm water management, low impact development (LID) is a design strategy that employs a variety of natural and engineered features to mimic natural hydrology to the greatest extent possible. LID employs a variety of natural and engineered features that help filter pollutants out of storm water runoff, reduce the rate of runoff and facilitate the infiltration of water into the ground.

LID strategies represent a shift away from sole reliance on traditional infrastructure (such as pipes, curbs, concrete ditches and channels) to manage and direct runoff. While traditional infrastructure is effective and sometimes necessary, recent research shows that an integrated system of small-scale control measures that encourage local infiltration, filtration, storage, evaporation and detention of runoff can be very efficient in improving water quality and reducing the volume and rate of storm water runoff.



1 Rain water from this city street flows through curb cuts into a planted storm water treatment area. The soil and plants improve the storm water quality through filtration and infiltration processes.

2 During larger storm events, excess water that the planted storm water system cannot accommodate will bypass the system and enter directly into the storm drain. Proper functioning of the facility requires regular removal of debris from the planted treatment area and curb cut inlets.

Storm Water Management Strategies

Left: Runoff from this Caltrans parking lot in San Diego flows into a storm water treatment area that also accommodates trees, landscaping and rock cobble. Right: Vegetation and soil intercept and treat storm water at the "Bogue Road Park and Ride," south of Yuba City.

On-site infiltration of runoff is a primary goal of storm water management. This approach reduces pollutant discharge and retains more water on-site. In some cases biofiltration strips and swales alone can meet infiltration requirements. In other areas, local site or environmental constraints may require the use of additional treatment strategies which can include infiltration and bioretention devices.

Early evaluation of the project site and local environmental factors will enable design solutions that best address water quality issues within a main street context.

Infiltration

Infiltration features include basins, trenches and other features that retain runoff, allowing it to infiltrate into the soil. These devices may be scaled to main street applications and can be designed to work in concert with adjacent bioretention and/or biofiltration features.

Biofiltration Strips and Swales

Biofiltration strips and swales are vegetated land areas, over which storm water travels. These features are effective at reducing runoff and removing pollutants. In most cases, flow attenuation is also provided, thus biofiltration swales and strips can also be considered a LID technique. Vegetation can include grasses, shrubs, trees and ground covers.

Bioretention

Bioretention areas are landscaped depressions or shallow basins used to slow and treat on-site runoff by employing a variety of storm water principles. These features are typically associated with treating smaller drainage areas and are a variation of Caltrans approved storm water best management practices.

Native and Site Appropriate Plants

Plants not only contribute to the aesthetic appeal of a main street, they can also contribute to local ecological health. Native vegetation in particular can provide food and shelter for wildlife and can help support other plants, insects and animals in the region's ecosystem. Selecting native or site appropriate plants that are adapted to thrive in the built environment with naturally occurring temperatures, rainfall and soil nutrients can help reduce maintenance requirements, minimize supplemental irrigation and reduce pollutants in storm water.

Preserving existing vegetation is an important design and construction consideration that can help the site retain its ecological value. Mature vegetation may be particularly valuable in protecting soils from erosion and in supporting local wildlife and beneficial insect populations.

To establish new vegetation, important considerations include preserving topsoil during construction, weed control, seasonal timing of planting, supplementing the soil with compost and mulch and planning for long-term maintenance.

The community livability benefits provided by trees and landscaping are discussed in Chapter 3.

- HDM, Chapter 900 - Highway Planting.
- Encroachment Permits Manual - Chapter 500.
- Caltrans Landscape Architecture website.

Site appropriate vegetation and storm water treatment are incorporated into this award winning downtown revitalization project.

Left: Along a city street in Sacramento, and State Route 16 in Esparto (right), trees cool pavement and buildings and contribute to a comfortable travel route for bicyclists, pedestrians and motorists.

Trees Benefit the Environment

Trees Clean the Air

Through the leaf structures that facilitate photosynthesis and gas exchange, trees remove gaseous pollutants from the air such as ozone, sulfur dioxide, nitrogen dioxide and carbon monoxide. Trees also intercept particulate matter, preventing it from becoming airborne. Airborne particulates can exacerbate health conditions such as asthma.

Trees Fight Climate Change

Trees capture atmospheric carbon and store it in their roots, foliage and wood. Removing and storing carbon dioxide from the atmosphere, known as carbon sequestration, is a primary strategy for combating climate change. Online calculators can help estimate rates of carbon sequestration, which vary by tree species, climate and other factors.

Trees Treat Storm Water

Trees, vegetation and their associated soils are often referred to as "green infrastructure" due to their ability to treat storm water runoff. By intercepting precipitation in their canopies, trees slow the speed and decrease the volume of runoff entering storm drains and downstream water bodies. Trees also improve water quality by taking up storm water pollutants through their roots.

Trees Cool Communities

Trees shade pavements and roof tops, which helps maintain more comfortable summertime temperatures. In hot weather, unshaded roofs and pavements can be heated to temperatures far above that of the surrounding air, creating what is called a "heat island." Heat islands increase summertime peak energy demands, air conditioning costs, air pollution, greenhouse gas emissions and heat-related illnesses.

Trees also cool the air via evapotranspiration. Evapotranspiration is the combination of the processes of evaporation and transpiration, which both release moisture into the air. Transpiration occurs when trees and other vegetation absorb water through their leaves, flowers and roots and emit it through their leaves. During evaporation, heat from the sun and the air changes water (found on wet surfaces such as soil or vegetation) from a liquid to a vapor. Evapotranspiration, alone or in combination with shading, can help reduce peak summer air temperatures and heat islands.

The page **"Additional Planting Resources"** at the end of Chapter 3 lists additional planting and tree selection guidance.

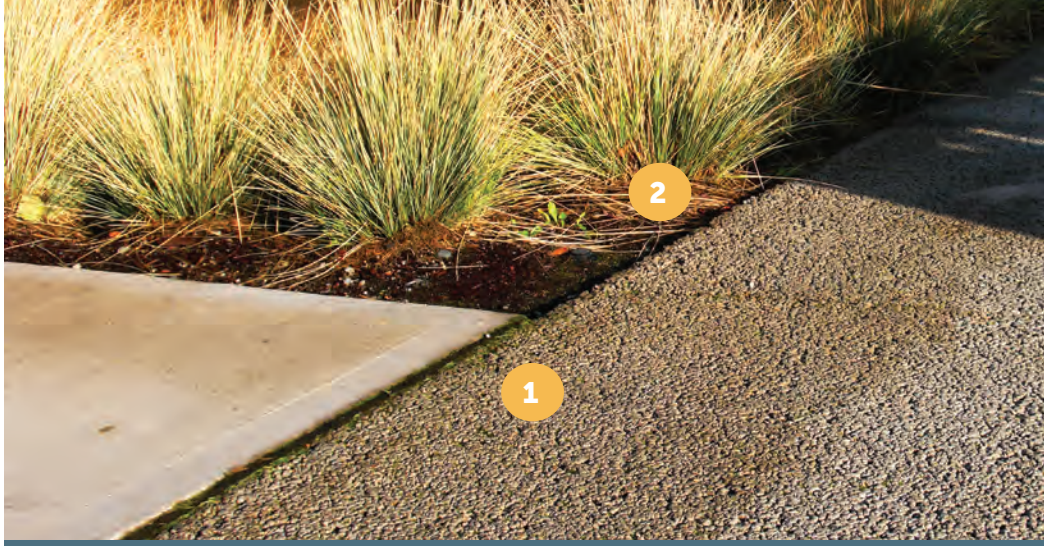
Water Conservation
State mandate requires that California communities adopt local water conservation ordinances to ensure that new development includes water efficient landscapes and that existing landscapes reduce water waste. In some cases, this can include the use of recycled water to irrigate landscaped areas. See Caltrans Deputy Directive (DD-13) for Water Conservation and the Model Water Efficient Landscape Ordinance for more information.

Emerging technologies also enable water conservation through the use of "smart controllers," which are irrigation controllers that can be networked and managed via wired or wireless communications. Smart controllers can remotely adjust irrigation levels to compensate for local weather conditions such as precipitation. Energy consumption and maintenance issues can also be monitored remotely. Combining water efficient plants with the ability to network irrigation controllers is a long-term cost effective strategy for reducing water consumption and maintenance expenditures.

Cooling Pavements
Cooling pavements can help address "heat islands," and during storm events, they can minimize the amount of pavement heat that is transferred to water bodies (elevated water temperatures can be damaging to aquatic ecosystems).

Used in lieu of conventional black asphalt, cooling pavements either reflect more solar radiation (thereby absorbing less heat) or are permeable surfaces which cool the pavement through water evaporation and air circulation. Decreasing the amount of heat absorbed by pavements can be achieved by using lighter materials such as concrete or using a lighter colored aggregate in asphalt paving mixes.

A variety of factors can affect pavement performance and life-cycle costs. While use of cooling pavements for roadway surfaces has potential environmental benefits, a Caltrans Division of Research and Innovation report recommends that more data be collected to study the durability, longevity and life-cycle costs of these technologies.



1 Permeable or pervious pavement uses fewer fine particles in the paving mix, which leaves voids within the pavement that allow water to infiltrate to the soil below.

2 Water efficient plants help conserve water and reduce irrigation requirements.

Permeable Pavements
Permeable paving consists of a range of paving materials that allow storm water to percolate and infiltrate through the paving material into the ground below. Appropriately sited, permeable pavements can be a storm water best management practice for main street applications along shoulders, parking areas and other locations not subjected to heavy vehicular traffic. The surface texture of any potential permeable paving material should be evaluated for suitability in pedestrian areas, with special attention to the vibration impacts on wheelchair users.

Like all paving, permeable paving requires routine sweeping and maintenance. For pervious pavement to function properly, sediment must be periodically removed by a sweeper equipped with an industrial vacuum. Neither pressure washing nor mechanical broom sweeping adequately removes sediment from the porous spaces that enable infiltration. A maintenance agreement may be appropriate to assign roles and responsibilities related to the use of specialized maintenance equipment and the level and frequency of maintenance.

Left: Pavement Recycling in Colusa County

Warm Mix Asphalt

Warm Mix Asphalt (WMA) is a term for the incorporation of additives during asphalt production that allow lower temperatures to be used during asphalt mixing and roadbed application. Since less energy is needed to heat the asphalt mix, less fuel is needed to produce WMA. The FHWA reports that fuel consumption during WMA manufacturing is typically reduced by 20 percent.

WMA also produces fewer emissions, which is better for air quality and improves working conditions by reducing exposure to fuel emissions and fumes. WMA may also result in labor and transportation cost savings since it is easier to transport, mix and compact.

Reused and Recycled Materials

Energy is required to extract, process, manufacture and deliver construction materials. Opportunities to "reduce, reuse and recycle" construction materials helps minimize environmental impacts of main street projects.

Some materials that no longer serve their original purpose can be recycled for a secondary use. Recycling allows construction material, such as concrete and asphalt, to be incorporated back into the new construction project as base material for the new roadway. Other types of materials that can be reused include guardrail, traffic signals, signs and sign standards.

Tire-derived aggregate (TDA), made from waste tires that are no longer suitable for use on vehicles, can be processed and used as either light-weight fill material or incorporated into making rubberized hot mix asphalt (RHMA). In either case, utilizing waste tire material can offer both engineering and economic benefits while minimizing the quantity of waste entering landfills.

Trees, plants and topsoil can also be salvaged and stockpiled at the beginning of projects and used to revegetate areas after construction. Trees and logs that need to be relocated can be placed as habitat features in some cases, or they can be converted to mulch for planting areas.

Energy Conservation and Lighting

LED (light-emitting diode) technology provides greater energy efficiency over other means of lighting. LED bulbs are long-lived, free of mercury and provide a focused light that can minimize light pollution. Like other electronic components, LED bulbs can be recycled.

Emerging technologies also enable street lights to be networked and managed via wired or wireless communications, which is often called "smart street lighting." Smart street lighting systems can be set so that street lights are dim until sensors detect people and cars. Lighting levels can also be remotely adjusted to compensate for local conditions such as inclement weather. Energy consumption and maintenance issues can also be monitored remotely.

Combining efficient hardware, such as LED bulbs, with networking ability, enables cost effective street light systems that can reduce energy consumption and maintenance expenditures.

Additional Caltrans Resources

Deputy Directive 13, Water Conservation
http://admin.dot.ca.gov/bfams/admin_svcs/sw_policy/dd/dd_by_number.html

Division of Research Innovation and System Information
"Cool Pavements Research and Technology: A Preliminary Investigation" Prepared by Levine, K., Institute of Transportation Studies (2011).
http://www.dot.ca.gov/newtech/researchreports/preliminary_investigations/docs/cool_pavements_preliminary_investigation.pdf

Landscape Architecture Program (LAP)
The LAP provides guidance regarding multi-modal transportation and facility design, highway planting, visual impact assessments, aesthetics, mitigation, roadside management, resource conservation, site planning and development, irrigation, water conservation and sustainable design.
http://www.dot.ca.gov/hq/LandArch/

Roadside Management Toolbox
An online decision making tool that can improve the safety, maintainability and sustainability of transportation projects.
http://www.dot.ca.gov/hq/LandArch/roadside/index.htm

Resource Conservation Program (RCP)
The RCP supports Caltrans stewardship goals to preserve and enhance California's resources and assets.
http://www.dot.ca.gov/hq/oppd/rescons/index.htm

Storm Water Resources:

Office of Storm Water Management - Design (OSWM)
The OSWM, in the Division of Design, emphasizes stewardship of California's water resources by providing technical assistance, guidance and training to designers.
http://www.dot.ca.gov/hq/oppd/stormwtr/index.htm

Statewide Storm Water Program
The Storm Water Program, in the Division of Environmental Analysis, provides guidance on appropriate storm water control activities during design, construction and maintenance of highway facilities.
http://www.dot.ca.gov/hq/env/stormwater/index.htm

Storm Water Quality Handbook Project Planning and Design Guide (PPDG)
The PPDG provides guidance on incorporating Best Management Practices (BMPs) into projects during the planning and design phases.
http://www.dot.ca.gov/hq/oppd/stormwtr/

Additional Resources

STATE AND FEDERAL RESOURCES

All information provided by sources external to Caltrans must be evaluated for consistency with Caltrans policies and guidance.

AASHTO Center for Environmental Excellence
The American Association of State Highway and Transportation Officials (AASHTO) Center for Environmental Excellence, in cooperation with the Federal Highway Administration promotes environmental stewardship.
http://environment.transportation.org/

EPA Green Infrastructure
The United States Environmental Protection Agency (EPA) developed a software tool that allows users to estimate the impact of land use change and green infrastructure controls on storm water runoff.
http://water.epa.gov/infrastructure/greeninfrastructure/index.cfm

FHWA Sustainable Highways Program
This Federal Highway Administration (FHWA) program facilitates balanced decision-making among environmental, economic and social values.
http://www.sustainablehighways.dot.gov/default.aspx

University of California at Davis, Road Ecology Center
A resource for sustainable transportation system information.
http://roadecology.ucdavis.edu/about.html

Urban Watershed Forestry Manual
From the Center for Watershed Protection and the Forest Service, topics include planting trees for storm water treatment, tree species selection, tree planting and maintenance, and other issues.
http://www.na.fs.fed.us/watershed/publications.shtm

USDA Forest Service Tree Carbon Calculator
The United States Department of Agriculture (USDA) Forest Service developed a software tool that provides quantitative data on carbon dioxide sequestration and building heating/cooling energy savings provided by individual trees.
http://www.fs.fed.us/ccrc/tools/ctcc.shtml

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Caltrans Landscape Architecture Program
http://www.dot.ca.gov/hq/LandArch/mainstreet/
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